Government of Karnataka
Department of Collegiate Education
GOVERNMENT COLLEGE (AUTONOMOUS),KALABURAGI
(Accredited by NAAC-'A' Grade)
Sedam Road,Kalaburagi-585105

Board of Studies in Chemistry(UG)

No	Name of the staff	Responsibilities	Phone No.	Signature
01	BeedeSuneelkumar Head of the Department Dept. ofChemistry. Government College Autonomous Kalaburagi-585105	Chairman	+91 9611488056	
02	Dr. K. Shivakumar Assistant Professor Dept. of Chemistry. Government College Autonomous Kalaburagi-585105	Member	+91 9740344126	
03	Roopa Kulkarni Assistant Professor Dept. of Chemistry. Government College Autonomous Kalaburagi-585105	Member	+91 9886200282	
04	Dr. Mahadev D. U Assistant Professor Dept. of Chemistry. Government College Autonomous Kalaburagi-585105	Member	+919980773833	

05	Dr. ShivarajMulage Chairman and Associate Professor Department of Chemistry V.G Womens Degree College, Kalaburagi-585102	Other University Member	+91 9482791897	
06	Sri. S.G. Huggi Patil Chairman and Associate Professor Department of Chemistry Akkamahadevi Degree College, Bidar 585401	Other University Member	+91 9449514705	
07	Dr. K. Siddappa Chairman and Professor Department of Studies and Research in Chemistry. Gulbarga University Kalaburagi-585106	University Member	+91 9845644075	
08	Vilas Biradar General Manager-QC Annora Pharma Pvt. Ltd. Annaram Village Sangareddy- 502313 Telangana State	Industrial Representative	+91 9908649014	
09	Shweta Manikappa At Post. Rajeshwar, Bidar	Alumni Student	+91 9036683553	

Course Pattern and Scheme of ExaminationForB.Sc.

as per NEP (2021-2022 and onwards)

Subject: CHEMISTRY

Sl. No	Semester	Course Type	Title of the Paper	Total Hours	Hours per week	Course Components			Examination pattern Max. and min Marks/ Paper			Duration of Examination	Total Credits
						Lecture	Tutorial	Practical	CIE	ESE	Total		
1	I	DSC-1	Analytical and Organic Chemistry-I	56	4	3	1	-	40	60	100	3 hours	4
2	I	DSC1L	Practicals I	56	4	-	-	4	25	25	50	3 hours	2
3	I	OE-1	Chemistry in daily life	42	3	2	1	-	40	60	100	3 hours	3
4	II	DSC-2	Inorganic and Physical Chemistry-I	56	4	3	1	-	40	60	100	3 hours	4
5	II	DSC2L	Practicals 2	56	4	-	-	4	25	25	50	3 hours	2
6	II	OE-2	Molecules of life	42	3	2	1	-	40	60	100	3 hours	3

- *DSC-: Discipline Specific Core
- DSCL: Discipline Specific Core Lab
- OE: Open Elective

1) 2) 3) 4) 5) 6) 7)

BA/BSc/BCom/BBA/BCA

BSc Semester 1 – Chemistry (Hons) with specialization in Analytical Chemistry

Title of the Course: DSC-1: Analytical and Organic Chemistry – I

Number of Theory Credits	Number of lecture hours/ semester	Number of practical Credits	Number of practical hours/ semesters
4	56	2	56

Content of Theory Course 1	56Hrs
Unit – 1	14
Language of analytical chemistry: Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Choice of an analytical method - accuracy, precision, sensitivity, selectivity, method validation. Figures of merit of analytical methods and limit of detection (LOD), Limit of quantification (LOQ), linear dynamic range (working range). Errors and treatment of analytical data: Limitations of analytical methods – Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors, Statistical treatment of finite samples -mean, median, range, standard deviation and variance. External standard calibration - regression equation (least squares method), correlation coefficient (R^2). Numerical problems Basic laboratory practices: calibration of glassware (pipette, burette and volumetric flask). Sampling (solids and liquids), weighing, drying, dissolving, Acid treatment, Rules of work in analytical laboratory. General rule for performing quantitative determinations (volumetric and gravimetric), Safety in Chemical laboratory, Rules of fire prevention and accidents, First aid. Precautions to be taken while handling toxic chemicals, concentrated/fuming acids and organic solvents.	
Unit - 2	14
Titrimetric analysis: Basic principle of titrimetric analysis. Classification. Preparation and dilution of reagents/solutions. Normality, Molarity and Mole fraction. Use of $N_1V_1 = N_2V_2$ formula, Preparation of ppm level solutions from source materials (salts), conversion factors. Acid-base titrimetry: Titration curves for strong acid vs strong base, weak acid vs strong base and weak base vs strong acid titrations. Titration curves, Quantitative applications – selecting and standardizing a titrant, inorganic analysis - alkalinity, acidity. Complexometric titrimetry: Indicators for EDTA titrations - theory of metal ion indicators, titration methods employing EDTA - direct, back, displacement and indirect determinations, Application-determination of hardness of water. Redox titrimetry: Balancing redox equations, calculation of the equilibrium constant of redox reactions, titration curves, Theory of redox indicators, calculation of standard potentials using Nernst equation. Applications. Precipitation titrimetry: Titration curves, titrants and standards, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences. Gravimetric Analysis: Requisites of precipitation, mechanism of precipitation, Factors influencing precipitation, Co-precipitation, post-precipitation, Advantages of organic reagents over inorganic reagents, reagents used in gravimetry (8-hydroxy quinoline (oxine) and dimethyl glyoxime (DMG). Numerical problems on all the above aspects.	
Unit - 3	14
Classification and nomenclature of organic compounds, Hybridization, Shapes of organic molecules, Influence of hybridization on bond properties. **Nature of bonding in Organic molecules** Formation of Covalent bond. Types of chemical bonding, localized and delocalized, conjugation and cross conjugation, concept of resonance, electronic displacements: Inductive effect, Electromeric effect, Resonance and Hyper conjugation, cross conjugation explanation with examples. Concept of resonance, aromaticity, Huckel rule, anti-aromaticity explanation with examples. Strengths of Organic acid and bases: Comparative study with emphasis on factors effecting pK values. Relative strength of aliphatic and aromatic carboxylic acids-Acetic acid and chloroacetic acid, acetic acid and propionic	

acid, acetic acid and Benzoic acid. Steric effect- Relative stability of trans and cis-2-butene. **Mechanisms of Organic Reactions** Notations used to represent electron movements and directions of reactions- curly arrows, formal charges. Types of bonds breaking- homolytic and heterolytic. Types of reagents-Electrophiles, nucleophiles, nucleophilicity and basicity. Types of organic reactions- substitution, addition, elimination, rearrangement and pericyclic reactions, explanation with examples Chemistry of Aliphatic hydrocarbons. Carbon-Carbon Sigma bonds Chemistry of alkanes: Formation of alkanes, Wurtz reaction, Wurtz-Fittig reaction, Free radical substitution. Halogenation- relative reactivity and selectivity **Carbon-carbon pi bonds** Formation of alkenes and alkynes by elimination reaction. Mechanism of E1, E2, E1cb reaction. Saytzeff and Hofmann eliminations. Addition of HBr to propene, Free radical addition of HBr to propene. Addition of halogens to alkenes-carbocation and halonium ion mechanism. Stereospecificity of halogen addition. Ozonolysis mechanism - ozonolysis of propene. Addition of hydrogen halides to alkenes, mechanism, regioselectivity and relative rates of addition. Hydrogenation, hydration, hydroxylation and epoxidation of alkenes, explanation with examples, 1,2 and 1,4- addition reactions in conjugated dienes. Diels-Alder reaction, Allylic and benzylic bromination and mechanism in propene, 1-butene, 1-toluene and ethylbenzene.	
Unit - 4	14
Nucleophilic substitution at saturated carbon. Mechanism of S_N1 and S_N2 reactions with suitable examples. Energy profile diagrams, Stereochemistry and factors effecting S_N1 and S_N2 reactions. Aromatic Electrophilic substitution reactions, Mechanisms, σ and π complexes, Halogenation, Nitration, Sulphonation, Friedel Crafts alkylation and acylation with their mechanism. Activating and deactivating groups. Orientation influence, Ortho-para ratio. Aromatic nucleophilic substitution reaction. S_NAr and Benzyne mechanism with suitable examples	

Text Books

1. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd.(2007).
2. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).
3. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).
4. Practical Volumetric Analysis, Peter A C McPherson, Royal Society of Chemistry, Cambridge, UK (2015).
5. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
6. Finar, I. L. *Organic Chemistry (Volume I)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
7. McMurry, J. E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013
8. Organic Reaction mechanism by V. K. Ahluwalia and K. Parashar (Narosa Publishers).
9. Organic Chemistry by S. M. Mukherji, S. P. Singh and R. K. Kapoor. (Narosa Publishers)
10. A Guide book to mechanism in Organic Chemistry by Peter sykes, Pearson.

References

Pedagogy

Formative Assessment	
Assessment Occasion/ type	**Weightage in Marks**
Internal Test	30
Sem End Exam	70
Total	100

Date Course Co-ordinator Subject Committee Chairperson

1) 2) 3) 4) 5) 6)

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Content of Practical Course 1: List of Experiments to be conducted

PART-A Analytical Chemistry

1. Calibration of glassware, pipette, burette and volumetric flask.
2. Determination of sodium carbonate and sodium bicarbonate in a mixture.
3. Determination of alkali present in soaps/detergents
4. Determination of iron(II) using potassium dichromate
5. Determination of oxalic acid using potassium permanganate solution
6. Standardization of EDTA solution and determination of hardness of water
7. Determination of Fe^{2+} as Fe_2O_3
8. Determination of Ni^{2+} as $Ni(DMG)_2$ complex.

PART-B Organic Chemistry

1. Selection of suitable solvents for Purification/Crystallization of organic compounds.
2. Preparation of acetanilide from aniline using Zn/acetic acid (Green method).
3. Synthesis of p-nitro acetanilide from acetanilide using nitrating mixture.
4. Bromination of acetanilide (i) Conventional method and/or (ii) with ceric ammonium nitrate and potassium bromide (Green method).
5. Hydrolysis of methyl m-nitrobenzoate to m-nitrobenzoic acid (Conventional method)
6. Synthesis of diazoaminobenzene from aniline (conventional method).
7. Preparation of dibenzalacetone (Green method).
8. Diels Alder reaction between furan and maleic acid (Green method).

BSc Semester 1 – Chemistry (Hons) with specialization in Analytical Chemistry

Title of the Course: OE-1: CHEMISTRY IN DAILY LIFE

Number of Theory Credits	Number of lecture hours/ semester	Number of practical Credits	Number of practical hours/ semesters
3	42	.	42

Content of Theory Course 1	42 Hrs
Unit – 1	14
Dairy Products Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk. Beverages: Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, determination of methyl alcohol in alcoholic beverages. **Food additives, adulterants, and contaminants**- Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners Aspartame, saccharin, dulcin, sucralose, and sodium cyclamate. Flavors Vanillin, alkyl esters (fruit flavors), and monosodium glutamate. **Artificial food colorants**: Coal tar dyes and non-permitted colors and metallic salts. Analysis of pesticide residues in food	
Unit - 2	14
Vitamins: Classification and Nomenclature. Sources, deficiency diseases, and structures of Vitamin A1, Vitamin B1, Vitamin C, Vitamin D, Vitamin E & Vitamin K1. **Oils and fats**: Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like argemone oil and mineral oils. Halphen test. **Soaps & Detergents**: Definition, classification, manufacturing of soaps and detergents, composition and uses.	
Unit - 3	14
Chemical and Renewable Energy Sources principles and applications of primary & secondary batteries and fuel cells. Basics of solar energy, future energy storer. **Polymers:** Basic concept of polymers, classification and characteristics of polymers. Applications of polymers as plastics in electronic, automobile components, medical fields, and aerospace materials. Problems of plastic waste management. Strategies for the development of environment-friendly polymers.	

Text Books

1. B. K. Sharma: Introduction to Industrial Chemistry, Goel Publishing, Meerut (1998)
2. Medicinal Chemistry- Ashtoush Kar.
3. Analysis of Foods – H.E. Cox: 13.
4. Chemical Analysis of Foods – H.E. Cox and Pearson.
5. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4th ed. New Age International (1998)
6. Physical Chemistry – P.I Atkins and J. de Paula – 7th Ed. 2002, Oxford University Press
7. Handbook on Fertilizer Technology by Swaminathan and Goswamy, 6th ed. 2001, FAI.
8. Organic Chemistry by I. L. Finar. Vol. 1 & 2. 9. Polymer Science and Technology. J. R. Fired (Prentice Hall).

References

1) 2) 3) 4) 5) 6)

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Pedagogy

Formative Assessment	
Assessment Occasion/ type	Weightage in Marks
Internal Test	30
Sem End Exam	70
Total	100

Date Course Co-ordinator Subject Committee Chairperson

1) 2) 3) 4) 5) 6)

7)

BSc Semester 2 – Chemistry (Hons) with specialization in Analytical Chemistry

Title of the Course: DSC – 2: INORGANIC AND PHYSICAL CHEMISTRY - I

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/ semesters
4	56	2	56

Content of Theory Course 2	56Hrs
Unit – 1	14
Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance. Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations- Electronic configurations of the elements (Z=1-30), effective nuclear charge, shielding/screening effect, Slater's rules. Variation of effective nuclear charge in Periodic Table.	
Unit - 2	14
s, p, d and f-block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s and p-block elements: (a) Atomic radii (van der Waals) (b) Ionic and crystal radii. (c) Covalent radii (d) Ionization enthalpy, successive ionization enthalpies and factors affecting ionization energy Applications of ionization enthalpy. (e) Electron gain enthalpy, trends of electron gain enthalpy. (f) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Trends in the chemistry of the compounds of groups 13 to 17 (hydrides, carbides, oxides and halides) are to be discussed.	
Unit - 3	14
Gaseous State Elementary aspects of kinetic theory of gases, ideal and real gases. Boyle temperature (derivation not required), Molecular velocity, collision frequency, collision diameter, Collision cross section, collision number and mean free path and coefficient of viscosity, calculation of σ and η, variation of viscosity with temperature and pressure. Maxwell's Boltzmann distribution law of molecular velocities (Most probable, average and root mean square velocities). Relation between RMS, average and most probable velocity and average kinetic energies. (Mathematical derivation not required), law of equipartition of energy. Behaviour of real gases: Deviation from ideal gas behaviour. Compressibility factor (Z) and its variation with pressure for different gases. Causes of deviation from ideal behaviour. vander Waals equation of stat (No derivation) and application in explaining real gas behaviour. Critical phenomena - Andrews isotherms of CO_2, critical constants and their	

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calculation from van der Waals equation, Continuity of states, Law of corresponding states. Numerical problems. **Liquid State** **Surface Tension**: Definition and its determination using stalagmometer, effect of temperature and solute on surface tension **Viscosity**: Definition, Coefficient of viscosity. Determination of viscosity of a liquid using Oswald viscometer. Effect of temperature, size, weight, shape of molecules and intermolecular forces. **Refraction**: Specific and molar refraction- definition and advantages. Determination of refractive index by Abbes Refractometer. Additive and constitutive properties. **Parachor**: Definition, Atomic and structure parachor, Elucidation of structure of benzene and benzoquinone. Viscosity and molecular structure. Molar refraction and chemical constitution. Numerical Problems.		
Unit - 4		14
Liquid.Crystals Explanation, classification with examples- Smetic, nematic, cholesteric, dics shaped and polymeric. Structures of nematic and cholesteric phases-molecular arrangements in nematic and cholesteric liquid crystals. Applications of liquid crystals in LCDs and thermal sensing. **Solids** **Forms of solids:** Unit cell and space lattice, anisotropy of crystals, size and shape of crystals. Laws of Crystallography: Law of constancy of interfacial angles, Law of rational indices, Law of symmetry (Symmetry elements), Crystal systems, Bravais lattice types and identification of lattice planes. Miller indices and its calculation, X–Ray diffraction by crystals: Bragg's law and derivation of Bragg's equation, Single crystal and powder diffraction methods. Defects in crystals, glasses and liquid crystals. Numerical problems. **Distribution Law** Nernst Distribution Law - Statement and its derivation. Distribution constant, factors affecting distribution constant, validity of Distribution Law, Modification of distribution law when molecules undergo a) Association b) Dissociation. Application of Distribution Law in Solvent extraction. Derivation for simple and multiple extraction. Principles of distribution law in Parkes Process of desilverisation of lead. Numerical Problems.		

Text Books

1. Concise Inorganic Chemistry. J D Lee, 4th Edn, Wiley, (2021)
2. Fundamentals Concepts of Inorganic Chemistry, Vol 1 and 2, 2nd Edition, Asim K Das, CBS Publishers and Distributors, (2013)
3. Basic Inorganic Chemistry, F A Cotton, G Wilkinson and P. L. Gaus, 3rd Edition. Wiley. India
4. Inorganic Chemistry, 2nd Edn. Catherine E. Housecroft and A.G. Sharpe, Pearson Prentice Hall (2005)
5. Atkins Physical Chemistry.8th Edition. Peter Atkins & Julio De Paula Oxford University Press.
6. Physical Chemistry by Samuel Glasstone, ELBS (1982).
7. A Text book of Physical Chemistry, A S Negi & S C Anand, New Age International Publishers (2007).
8. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co.
9. A Text Book of Physical Chemistry P.L.Soni , O.P. Dharmarhaand and U.N.Dash, Sultan Chand and Sons.
10. Advanced Physical Chemistry, Gurdeep Raj, Goel Publishing House (2018)

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References

Pedagogy

Formative Assessment	
Assessment Occasion/ type	Weightage in Marks
Internal Test	30
Sem End Exam	70
Total	100

Date Course Co-ordinator Subject Committee Chairperson

Content of Practical Course 2: List of Experiments to be conducted

PART-A Inorganic Chemistry

TITRIMETRY

1. Determination of carbonate and hydroxide present in a mixture.
2. Determination of oxalic acid and sodium oxalate in a given mixture using standard $KMnO_4$/NaOH solution
3. Standardization of potassium permanganate solution and determination of nitrite in a water sample
4. Standardization of silver nitrate and determination of chloride in a water sample (demonstration)
5. Determination of alkali content in antacids
6. Determination of chlorine in bleaching powder using iodometric method.

GRAVIMETRY

1. Determination of Ba^{2+} as $BaSO_4$
2. Determination of Cu^{2+} as CuSCN

PART-B Physical Chemistry

1. Safety Practices in the Chemistry Laboratory, Knowledge about common toxic chemicals and safety measures in their handling, cleaning and drying of glassware's
2. Determination of density using specific gravity bottle and viscosity of liquids using Ostwald's viscometer (Ethyl acetate, Toluene, Chloroform, Chlorobenzene or any other non-hazardous liquids)
3. Study of the variation of viscosity of sucrose solution with the concentration of a solute
4. Determination of the density using specific gravity bottle and surface tension of liquids using Stalagmometer (Ethyl acetate, Toluene, Chlorobenzene, any other non-hazardous liquids
5. Study of variation of surface tension of detergent solution with concentration.
6. Determination of specific and molar refraction by Abbes Refractometer. (Ethyl acetate, Methyl acetate, Ethylene Chloride)
7. Determination of the composition of liquid mixture by refractometry. (Toluene & Alcohol, Water & Sucrose)
8. Determination of partition/distribution coefficient - i) Acetic acid in water and cyclohexane. ii) Acetic acid in Water and Butanol. iii) Benzoic acid in water and toluene.

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BSc Semester 2 – Chemistry (Hons) with specialization in Analytical Chemistry

Title of the Course: OE – 2: Molecules of Life

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/ semesters
3	42	-	42

Content of Theory Course 2	42 Hrs
Unit – 1	14
Carbohydrates Classification of carbohydrates, reducing and non-reducing sugars, General properties of glucose and fructose, their open chain structures. Epimers, mutarotation and anomers. Linkage between monosaccharides, structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation. **Amino Acids, Peptides and Proteins** Classification of amino acids, Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides.	
Unit - 2	14
Enzymes and correlation with drug action Mechanism of enzyme action, factors affecting enzyme action, Co-enzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity). Enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and Non competitive inhibition including allosteric inhibition). **Drug action**-receptor theory. Structure–activity relationships of drug molecules, binding role of –OH group, $-NH_2$ group, double bond and aromatic ring **Lipids** Introduction to lipids, classification. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).	
Unit - 3	14
Nucleic Acids Components of nucleic acids: Adenine, guanine, thymine and cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (**nomenclature**). Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (**types of RNA**), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation. **Concept of Energy in Biosystems** Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrate- Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.	

1) 2) 3) 4) 5) 6)

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Text Books

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry (Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.*,
5. W. H. Freeman. Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, , 2002.

References

Pedagogy

Formative Assessment	
Assessment Occasion/ type	Weightage in Marks
Internal Test	30
Sem End Exam	70
Total	100

Date Course Co-ordinator Subject Committee Chairperson

1) 2) 3) 4) 5) 6)

7)

Government of Karnataka
Department of Collegiate Education
GOVERNMENT COLLEGE, KALABURAGI
(AN AUTONOMOUS INSTITUTION)
Department of Chemistry

Proceedings of the Board of Studies in Chemistry (UG)

The meeting of the Board of studies (UG) in Chemistry for the academic year **2022-23** was held on **17-10-2022** at **10.30** AM in the department of Chemistry, Government College, Kalaburgi (an autonomous institution). The committee discussed on draft syllabus (revision/new) of undergraduate courses of Chemistry of B.Sc III and IV semester of **NEP, (DSC-3 and DSC-4)** and approved as below.

Program Name	Course code	Course Name	Revision/ New course	% of Revision in case of revision	Remarks
B.Sc. III SEMESTER					
B.Sc.	DSCT-3	Analytical & Organic Chemistry -II	New Course	100	
	DSCP -3	Analytical & Organic Chemistry Practical	New Course	100	
	DSC -3 OPEN ELECTIVE	Atomic Structure, Bonding and Concepts in Organic Chemistry	New Course	100	
B.Sc. IV SEMESTER					
B.Sc.	DSC -4	Inorganic & Physical chemistry - II	New Course	100	
	DSC -4	Inorganic & Physical chemistry Practical	New Course	100	
	DSC -4 OPEN ELECTIVE	Electrochemistry, Corrosion and Metallurgy	New Course	100	

HEAD OF DEPARTMENT
DEPARTMENT OF CHEMISTRY
Govt. College (Autonomous)
KALABURAGI

Government of Karnataka
Department of Collegiate and Technical Education
GOVERNMENT COLLEGE KALABURAGI (AN AUTONOMOUS INSTITUTION)-585105.
Phone: 08472-245064 (Re-Accredited by NACC with "A" Grade) www.gcak.ac.in

Ref No.: GCK(AI)/BOS(UG)/2022-23/72 Date : 17/10/2022

OFFICE ORDER

Subject : Appointment of members of Board of Studies (UG)

Reference: 1. UGC Revised Guidelines for Autonomous Colleges dt. : 19.01.2018

2. Registrar, GUK Letter No. ಗುವಿಕ/ಶೈಮವಿ/ಜಿ.ಎಸ್/2017-18/2547 Dated 24.01.2018

3. Resolution of the DC meeting held on 17/10/2022

Advert to the cited subject and references, the Board of Studies (UG) have been constituted as shown below.

Board of Studies (UG) in CHEMISTRY

Sl No.	Name of the Members	Designation	Address with Phone No & Email	Appointed as
1	Prof. Gajre Vaman	Asso. Prof.	vamangajre66 @gmail.com	Chairman
2	Prof. Beede Suneelkumar	Assis.Prof.	naguyogi_beede @rediffmail.com	Member
3	Dr. Shivakumar K	Assis.Prof.	Shivu_chem @rediffmail.com	Member
4	Dr. Vijayanand V	Assis.Prof.	v_havanoor @rediffmail.com	Member
5	Prof. Roopa Kulkarni	Assis.Prof.	Shrishk.rk @gmail.com	Member
6	Dr. Mahadev U	Assis.Prof.	Mahadev510 @gmail.com	Member
7	Dr. Shivaraj Mulgi	Asso. Prof.	mshiva25 @rediffmail.com	External Member (other than parent University)
8	Dr. Dhondiba Vishwanath	Assis.Prof.	dhondibavishsurya123 @gmail.com	External Member (other than parent University)
9	Dr. K Siddappa, Professor and Chairman Department of P. G. Studies and Research in Chemistry Gulbarga University, Kalaburgi-585106	Asso. Prof.	Siddappak1965 @gmail.com	University Nominee
10	Devendra Lingappa Priyanka agro tech.Plot No.124,kapnoor Indl. area, Humnabad road, Kalaburgi	Industrialist Representative	Devendralingappa8 @gmail.com 9141363430	External Member representing Industry
11	Dr. Ashwajeet J S Assistant Professor Department of studies in Physics Davanagere University, Shivagangotri Davanagere-577002	Assis.Prof.	ashphysics358 @gmail.com 9481584358	Alumni Member

The term of nominated members shall be 03 years from the date of this Order.

Copy to:

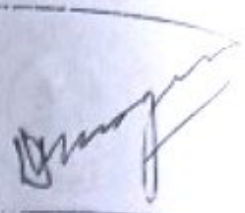
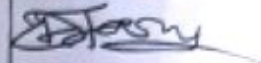
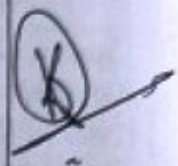
1. Chairman, Board of Studies (UG) in CHEMISTRY
2. All the members of the BOS
3. Academic Dean (UG) Govt. College (Autonomous), Kalaburagi
4. Office Copy.

PRINCIPAL
Govt. College (Autonomous)
Kalaburagi-585 105

Government of Karnataka
Department of Collegiate Education
GOVERNMENT COLLEGE, KALABURAGI
(AN AUTONOMOUS INSTITUTION)
(Accredited by NAAC-'A' Grade)
Sedam Road, Kalaburagi-585105

Board of Studies in Chemistry (UG)

S. No.	Name of the Staff	Responsibilities	Phone No.	Signature
1.	**Vaman Gajre** Associate Professor Head of the department of Chemistry Government college Autonomous Kalaburagi	Chairman	9916952204	
2.	Beede Suneel Kumar Associate Professor Department of Chemistry Government college Autonomous Kalaburagi	Member	9611488056	
3.	Dr. K. Shivkumar Associate Professor Department of Chemistry Government college Autonomous Kalaburagi	Member	9740344126	
4.	Dr. Vijayanand V Assistant Professor Department of Chemistry Government college Autonomous Kalaburagi	Member	9880869032	
5.	Roopa Kulkarni Assistant Professor Department of Chemistry Government college Autonomous Kalaburagi	Member	9886200282	
6.	Dr. Mahadev U Assistant Professor Department of Chemistry Government college Autonomous Kalaburagi	Member	9980773833	
7.	Dr. Shivaraj Mulgi Associate Professor Department of Chemistry V. G. Womens degree college Kalaburagi- 585102	External Member	9482791897	

8.	Dr. Dhondiba Vishwanth Associate Professor Department of Chemistry Government Womens College, Kalaburagi	External Member	9844794305	
9.	Devendrappa Lingappa Priyanka agro tech, Plot No. 124, Kapnoor Industrial Area, Humnabad road Kalaburagi	Industrial Representative	9141363430	
10.	Prof. K. Siddappa Professor and Chairman Department of P.G. Studies and Research In chemistry Gulbarga University Kalaburagi- 585106	University Nominee	9845644075	
11.	Dr. Ashwajeet J S Assistant Professor . Deparment of Physics Davangere University Shivagangotri Davangere-577002	Alumni Member	9481584358	

GOVERNMENT COLLEGE, KALABURAGI
(AN AUTONOMOUS INSTITUTION)
Department of Chemistry

B.Sc. III and IV Semester NEP syllabus with effect from 2022-2023 on wards

Third Semester

DSC-3 : Analytical Chemistry-II		**28hrs**
Unit - I	: Quantitative analysis	14 hrs
Unit –II	: Separation Method	14 hrs
DSC-3: Organic Chemistry-II		**28hrs**
Unit -III	: Reaction Intermediates	14 hrs
Unit -IV	: Stereochemistry of Organic Compounds	14hrs
DSC-3 : Laboratory Course-II		**56hrs**
Part-A	: Analytical Chemistry-II	28hrs
Part-B	: Organic Chemistry-II	28hrs
OE-3 : Atomic Structure, Bonding and Concepts in Organic Chemistry		**42hrs**

Fourth Semester

DSC-4 : Inorganic Chemistry-II		**28hrs**
Unit - I	: Structure and Bonding-I	14 hrs
Unit –II	: Structure and Bonding-II	14 hrs
DSC-4: Physical Chemistry-II		**28hrs**
Unit -III	1. First law of Thermodynamics	
	2. Second law of Thermodynamics	
	3. Third law of Thermodynamics	
	4. Surface Chemistry	14hrs
Unit –IV	1.Chemical Kinetics	
	2. Electrochemistry-I	14 hrs
DSC-4 : Laboratory Course-II		**56hrs**
Part-A	: Inorganic Chemistry-II	28hrs
Part-B	: Physical Chemistry-II	28hrs
OE-4 : Electrochemistry, Corrosion and Metallurgy		**42 hrs**

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TEACHING HOURS

Semester	Theory	Practical
DSC-III and DSC-IV	4 hours/week	2x2 hours/week
OE- III and OE- IV	3 hours/week	-----

SCHEME OF EXAMINATIONS:

1. There shall be one question paper each for B.Sc. DSC-III and DSC-IV Semester Chemistry Examination
2. There shall be one question paper each for B.Sc. OE- III and OE- IV Semester Chemistry Examination
3. In addition there shall be Practical Examination as per the Autonomous College Regulations existing from time to time.

SCHEME OF MARKING

Semester	Theory	Exam hours	Marks	Internal Assessment	Total Marks
DSC-III and DSC-IV	Paper – 3 ,4	2.30 hours	60 marks	40 marks	100 marks
OE- III and OE- IV	Paper – 3 ,4	2.30hours	60 marks	40 marks	100 marks

Note: The internal assessment marks for theory shall be **forty** and for practical's **twenty**.

DISTRIBUTION OF MARKS FOR PRACTICAL EXAMINATION

Experiment	Internal Assessment	Total marks
25 Marks	25 marks	50 marks

Note: The candidate should produce the certified journal at the time of each semester examination. In case the candidate fails to submit the certified journal, the laboratory supervisor should give the certificate in this regard. However, no marks shall be given for such certificate.

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The committee also approved the syllabus of above course.

To approve the Pattern of Question Paper DSCT.

It is resolved to adopt the following pattern of question paper.

Scheme of Examination:

1. There shall be one question paper each for B.Sc III[rd] and IV[th] semesters in Chemistry
2. In addition, there shall be Practical Examinations as per the Autonomous Regulations existing from time to time.

Question paper pattern:

Each question paper shall contain three sections (**Section-A, Section-B and Section-C**) & Minimum **ONE** question from each unit should be taken.

III[rd] and IV[th] Sem DSC-3 and DSC-4 :

Section –A: (05 x 2 = 10 Marks) – Two marks **seven** questions given, candidates has to answer any **five** questions.

Section– B: (04 x 5 = 20 Marks) Five marks **six** questions to be given, candidates has to answer any **four** questions.

Section–C: (03 x 10 = 30 Marks) – Ten marks **five** questions to be given; candidate has to answer any **three** questions.

****

The committee also approved the syllabus of above courses.
To approve the Pattern of Question Paper OE.

It is resolved to adopt the following pattern of question paper.

Scheme of Examination: OPEN ELECTIVE (OE)

There shall be one question paper each for B.Sc III[rd] and IV[th] semesters in Chemistry

Question paper pattern:

Each question paper shall contain three sections (**Section-A. Section-B and Section-C**) & Minimum **ONE** question from each unit should be taken.

III[rd] and IV[th] Sem OPEN ELECTIVE (OE):

Section –A: (05 x 2 = 10 Marks) – Two marks **seven** questions given, candidates has to answer any **five** questions.

Section – B: (04 x 5 = 20 Marks) Five marks **six** questions to be given, candidates has to answer any **four** questions.

Section –C: (03 x 10 = 30 Marks) – Ten marks **five** questions to be given, candidate has to answer any **three** questions.

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Course Matrix and Scheme of Examination of Bachelor of Science in Chemistry
as per NEP (With effect from the Academic year 2022-23 onwards)
Subject : CHEMISTRY

Course Code	Title of the Course	Total hours	Hours per week	Course components			Examination pattern Max. & Min. Marks/Paper			Duration of Examination	Total credits
				Lecturer	Tutorials	Practical	CIA	SEE	Total		
Semester-III											
DSC-3	Analytical & Organic Chemistry -II	56	4	3	1	-	40	60	100	2.30hrs	4
DSC -3	Analytical & Organic Chemistry Practical	56	4			4	25	25	50	2hrs	2
DSC -3 OPEN ELECTIVE	Atomic Structure, Bonding and Concepts in Organic Chemistry	42	3	2	1		40	60	100	2.30hrs	3
Semester-IV											
DSC -4	Inorganic & Physical chemistry -II	56	4	3	1		40	60	100	2.30hrs	4
DSC -4	Inorganic & Physical chemistry Practical	56	4			4	25	25	50	2hrs	2
DSC -4 OPEN ELECTIVE	Electrochemistry, Corrosion and Metallurgy	42	3	2	1		40	60	100	2.30hrs	3

Note: Course = DSCT: Discipline Specific Core Course,
DSCL: Discipline Specific Core Lab,
OE: Open Elective
L=Lecture, T=Tutorial, P=Practical,

DSC-3: Analytical and Organic Chemistry-II

Contact Hours: 56 Work load: 4 Hrs/Week. Credit Points: 4

Evaluation: Continuous Internal Assesment-40 Marks

Semester End Examination-60 Marks

Course Objectives:

1) Interrelationship among frequency, wavelength and wave number and importance of validation parameters of an instrumental method will be taught
2) Principle, instrumentation and applications of spectrophotometry, nephelometry and turbidometry will be taught
3) Fundamentals of separation methods and principles of paper, thin layer and column chromatography will be taught
4) Principle, types and applications of solvent extraction will be taught
5) Principle and mechanism of ion-exchange, types of resins and domestic and industrial applications of ion-exchange chromatography will be taught
6) The concept of mechanism and its importance will be taught to the student
7) Concept and importance of intermediates in organic chemistry will be taught taking proper examples
8) The various techniques for identification of reaction mechanism will be taught to the student taking proper examples
9) Concept of stereochemistry and its importance will be taught.
10) The various projection formulae and the techniques of designating the molecules into R, S, D, L will be taught taking proper examples
11) The theory and concept of Cis-, Trans- isomerism and its importance and the techniques to differentiate between them will be taught taking examples

Course Specific Outcomes

After the completion of this course, the student would be able to

1) Understand the importance of fundamental law and validation parameters in chemical analysis
2) Know how different analytes in different matrices (water and real samples) can be determined by spectrophotometric, nephelometric and turbidometric methods.
3) Understand the requirement for chemical analysis by paper, thin layer and column chromatography. Apply solvent extraction method for quantitative determination of metal ions in different samples
4) Utilize the ion-exchange chromatography for domestic and industrial applications
5) Explain mechanism for a given reaction.
6) Predict the probable mechanism for an reaction. Explain the importance of reaction intermediates, its role and techniques of generating such intermediates.
7) Explain the importance of Stereochemistry in predicting the structure and property of organic molecules.
8) Predict the configuration of an organic molecule and able to designate it.
9) Identify the chiral molecules and predict its actual configuration

Unit-I

Quantitataive analysis-Instrumental methods

Electromagnetic spectrum, absorption of electromagnetic radiation, Definition and units of frequency, wavelength, wave number. Beer's law, Beer-Lambert law derivation, deviations from Beer's law, limitations, construction of calibration graph (Plot of absorbance versus concentration). Evaluation Procedures- standard addition, Internal standard addition, validation parameters-detection limits, sensitivity, dynamic/linearity range. Instrumentation, single beam and double beam spectrophotometers, quantitative applications of colorimetry (determination of Fe, Mo, Cu, Ti and $PO4^{3-}$) and numerical problems on application of Beer's law. **10 hrs**

Nephelometry and Turbidimetry: Introduction, principle, instrumentations of nephelometry and turbidimetry; effects of concentration, particle size and wavelength on scattering; choice between nephelometry, applications of nephelometry and turbidimetry (determination of $SO4^{2-}$ and $PO4^{3-}$) **4 hrs**

Unit-II

Separation methods

Fundamentals of chromatography: General description, definition, terms and parameters used in chromatography, classification of chromatographic methods, criteria for selection of stationary and mobile phase and nature of adsorbents. Principles of paper, thin layer, column chromatography. Column efficiency, factors affecting the column efficiency, van Deemter's equation and its modern version. **3hrs**

Paper chromatography: Theory and applications

Thin layer chromatography (TLC): Mechanism, Rf value, efficiency of TLC plates, methodology–selection of stationary and mobile phases, development, spray reagents, identification and detection, qualitative applications. **4 hrs**

Solvent Extraction: Types- batch, continuous, efficiency, selectivity, distribution coefficient, Nernst distribution law, derivation, factors affecting the partition, relationship between % extraction and volume fraction. Numerical problems on solvent extraction. Solvent extraction of iron and copper. **4hrs**

Ion exchange chromatography: resins, types with examples- cation exchange and anion exchange resins, mechanism of cation and anion exchange process and applications of ion-exchange chromatography (softening of hard water, separation of lanthanides, industrial applications). **3hrs**

Unit-III

Reaction Intermediates: Generation, Stability and Reactions of,

i) Carbocations: Dienone-phenol and Pinacol-Pinacolone Rearrangement.
ii) Carbanions : Perkin Reaction, Aldol condensation, Claisen-Schmith condensation.
iii) Free Radicals : Sandmeyer's Reaction
iv) Carbenes and Nitrenes: Singlet and Triplet states, their relative stability and reactions
v) Arynes: Formation, detection etc. **8 hrs**

Methods for Identifying Reaction Mechanism:

Product analysis, Isolation and Identification of Intermediates, Stereochemical Evidences, Effect of Catalyst, crossover Experiments, Isotopic studies, Kinetic Studies. **6 hrs**

Unit-IV

Stereochemistry of Organic Compounds:

Fischer projection, Newmann and Sawhorse projection formulae and the interconversions. Geometrical isomerism : Cis-trans and syn-anti isomerism, E/Z notations with C.I.P rules. Optical Isomerism : Optical activity, Specific rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral centres, Diasteroisomers, meso structures, Racemic mixtures and Resolution, Relative and absolute configuration, D/L and R/S designations

14 hrs

References:

1) Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).
2) Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).
3) Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, PHI Learning Pvt Ltd.New Delhi(2009).
4) Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd.(2007).
5) Organic Reaction Mechanism by V.K.Ahluwalia and R.K.Parashar (Narosa Publishers)
6) Organic Chemistry by S.M.Mukherji,S.P.Sinh and R.K.Kapoor (Narosa Publishers)
7) Morrison R.N and Boyd R.N,OrganicChemistry,Darling Kindersley (India) Pvt.Ltd.(Pearson Education)
8) Finar I.L,Organic Chemistry(Volume I); Finar I.L (Volume II) Stereochemistry and the Chemistry of Natural Products.,Dorling Kindersley(India)Pvt.Ltd.(Pearson Education)
9) Kalsi P.S.Stereochemistry,conformation and Mechanism,New age International
10) Eliel E.L and wilenS.H,Stereochemistry of Organic Compounds,Wiley,(London)

PRACTICALS

Credit Points: 2 **Teaching Hours:4 hrs**

Evaluation : Continuous Internal Assessment-25marks

Semester End Examination-25marks

Course Objectives

1) To impart skills related to preparation of stock and working solutions and handling of instrumental methods
2) To know the principle of colorimetric analysis and construction of calibration plot
3) To understand the chemistry involved in colorimetric determination of metal ions and anions
4) To determine R_f values of different metal ions present in a mixture
5) To impart knowledge on the importance of functional groups in organic compounds.
6) Techniques to identify the functional groups in an compound by performing physical and chemical tests
7) To record its melting point/boiling point.
8) To prepare suitable derivative for that compound and to characterize it.

Course Specific outcomes

After the completion of this course, the student would be able to

1) Understand the importance of instrumental methods for quantitative applications
2) Apply colorimetric methods for accurate determination of metal ions and anions in water or real samples
3) Understand how functional groups in an compound is responsible for its characteristic property
4) Learn the importance of qualitative tests in identifying functional groups.
5) Learn how to prepare a derivative for particular functional groups and how to purify it

Sl. No.	Name of the Experiment	Hours
PART-A (Analytical Chemistry)		
1	Identify and separate the sugars present in the given mixture by paper chromatography.	2
2	Determine the specific rotation of cane sugar solution using polarimeter	2
3	Colorimetric determination of nickel using DMG solution	4
4	Colorimetric determination of titanium using hydrogen peroxide	4
5	Colorimetric determination of nitrite in a water sample (diazo coupling Reaction/Griess reagent	4
6	Colorimetric determination of phosphate as ammonium phosphomolybdate	4
7	Determination of Rf values of two or three component systems by TLC	2
8	Separation of different metal ions by Solvent extraction of iron using oxine solution **(demonstration)**	4
PART-B (Organic Chemistry) Qualitative analysis of **mono** and **bi**functional Organic compounds such as		
1	Benzoic acid, Salicylic acid, p-Nitro benzoic acid, p-Chloro benzoic acid	8
2	α-Napthol, β-Napthol, Resorcinol, o-Nitrophenol, p-nitophenol	8
3	Aniline, o-Nitroaniline, p-Nitroaniline, p-Toluidine, p-Chloroaniline,	8
4	Benzaldehyde, Acetanilide, dichlorobenzene Ethyl Salicylate, Salicylaldehyde, Acetophenone, p-Dichlorobenzene, p-Nitro toluene, Benzamide etc.	8

References:

1. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt. Ltd., 2007
2. Vogel's Textbook of Practical Organic Chemistry, Including Qualitative Organic analysis, A.I Vogel and B.S. Furniss, Longman Publishers, 1978

1. 2. 3. 4. 5. 6.

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B.Sc. Semester III – Chemistry (Hons): Analytical/ Organic/ Inorganic/ Physical Specialization

Contact Hours: 42 Work load: 3 Hrs/Week. Credit Points: 3

Evaluation: Continuous Internal Assesment-40 Marks

Semester End Examination-60 Marks

Title of the Course: **Open Eelective-3 : Atomic Structure, Bonding and Concepts in Organic Chemistry**

Course Objectives:

- To develop an understanding of principles of Atomic structure
- To know the importance of quantum numbers, writing of electronic configurations and representation of orbital's
- To develop an understanding of the periodic trends
- To understand the nature of bonding and to predict the shapes of molecules
- To construct MO energy level diagrams and predict the properties of molecules
- To understand the formation of sigma and pi bonds and the bond strength.
- To study the classification of organic reactions
- To learn nomenclature preparation and reactions of alkanes, alkenes, alkynes and stability of alicyclic compounds

COURSE CONTENT

Unit I: Atomic Structure and Periodic Properties

History of an atom. Idea of de Broglie matter waves. Heisenberg uncertainty principle. Schrödinger wave equation, significance of wave functions, Bohr's model of hydrogen atom and its limitations. Quantum numbers and their importance, atomic orbitals and shapes of s, p, d orbitals , Multi-electron atoms, Aufbau and Pauli exclusion principle and Hund's multiplicity rule- Electronic configurations of the elements (atomic no. up to 30), effective nuclear charge and shielding.

08 Hrs

Periodic Properties

Atomic radius, Covalent, ionic and van der Waal radii-explanation with examples. Definition and periodicity of the following properties - ionic radii, ionization potential, electron affinity and electronegativity, methods of determination of electronegativity. Factors affecting the values of ionisation energy.

06 Hrs

Unit II: Chemical Bonding

Ionic Solids– Ionic structures(NaCl, CsCl, TiO_2, ZnS), radius ratio rule and coordination number limitation of radius ratio rule, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule and their consequences

04 Hrs

Covalent Bond – Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization with examples and shapes of simple inorganic molecules and ions. Shapes of NH_3, I_3^+, I_3^-, SF_4, ClF_3, IF_5, ICl_2^- and H_2O using valence shell electron pair repulsion (VSEPR) theory, linear combination of atomic orbitals (LCAO), bonding, nonbonding and antibonding molecular orbitals, physical picture of bonding and antibonding wave functions. Applications of MO theory to explain the stability of homo dinuclear (He_2, N_2, O_2, F_2, C_2) and hetero dinuclear (NO and CO) molecules. Comparison of M.O. and V.B. Models. **07 Hrs**

Metallic bond-free electron, Band theory-electrical properties of metals, semiconductors and insulators. Weak interactions – Hydrogen bonding and its consequences, van der Waals forces.

03 Hrs

Unit III:

Bonding and molecular structure and hydrocarbons

Bonding and molecular structure: Introduction to organic chemistry,atomic orbitals,sigma and pi bond formation-molecular orbital [MO]method,sp,$sp^2$and sp^3 hybridization,bond length,bond dissociation energies and bond angles(open chain and cyclic compounds).Electronegativity and polarity of the bonds.Classification and reactions of organic compounds(with examples).

07 Hrs

Alkanes,Alkenes and Alkynes

Definition, Nomenclature, preparations (any two methods)

Reactions: Electrophilic, nucleophilic and free radical addition reactions

Alicyclic compounds:

Nomenclature, preparation and stability of cyclopropane, cyclobutane, cyclopentane and cyclohexane.

07 Hrs

Reference Books:

1. Concise Inorganic Chemistry, J. D. Lee, ELBS,1996.
2. Inorganic Chemistry, A. K. Das
3. Inorganic Chemistry: Principles of Structure and Reactivity, Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O. K.PearsonEducationIndia,2006.
4. Inorganic Chemistry, Shriver,D.F.&Atkins, P.W.Oxford UniversityPress.
5. Schaum's Outline Series Theory and Problems of Organic Chemistry.SI (metric) edition Herbert Meislich, Howard Nechamkin and Jacob Sharefkin.
6. Organic chemistry. Robert T.Morrison Robert N. Boyd,6thEdition
7. Organic Chemistry Volume-1, I.L.Finar

COURSE OUTCOME:

On completion of the course the student will learn and be able to understand/explain

- The concept of atomic structure, significance of quantum numbers, filling of electrons of atoms/ions in various orbital's as per rules
- The trends in periodic properties
- The structures of ionic solids, applications of B-H cycle, solubility of compounds and consequences of polarization of ions
- The shapes of molecules/ions based on VSEPR theory
- The construction of MO energy level diagrams and prediction of properties of molecules/ions like bond order, bond energies, bond lengths and magnetic properties.
- The formation of sigma and pi bonds and the bond strength
- The classification of organic reactions
- Nomenclature preparation, and reactions of alkanes, alkenes, alkynes and stability of alicyclic compounds.

CHEMISTRY

DSC-4: Inorganic and Physical Chemistry-II

Contact Hours: 56 Work load: 4 Hours/Week. Credit Points :4

Evaluation: Continuous Internal Assessment -40Marks

Semester End Examination -60 Marks

Course Objectives:

Students learn about

1. Different types of bonding in molecules/compounds/ions
2. The structures of molecules/compounds/ions based on different models/theories
3. Properties of compounds based on bonding and structure
4. The fundamentals of thermodynamics including the laws, the concept of entropy and free energy functions and their applications.
5. The concepts of surface chemistry, catalysis and their applications.
6. The theoretical and experimental aspects of chemical kinetics including basic theories of reaction rates and methods of determining order.
7. Electrochemistry dealing with electrolytes in solution. Conductance measurements and applications. Concept of ionic mobility and their determination.

Course outcomes: After the completion of this course, the student would be able to

1. Predict the nature of the bond formed between different elements
2. Identify the possible type of arrangements of ions in ionic compounds
3. Write Born – Haber cycle for different ionic compounds
4. Relate different energy parameters like, lattice energy, entropy, enthalpy and salvation energy in the dissolution of ionic solids
5. Explain covalent nature in ionic compounds
6. Write the M.O. energy diagrams for simple molecules
7. Differentiate bonding in metals from their compounds
8. Learn important laws of thermodynamics and their applications to various thermodynamic systems
9. Understand adsorption processes and their mechanisms and the function and purpose of a catalyst
10. Apply adsorption as a versatile method for waste water purification.
11. Understand the concept of rate of a chemical reaction, integrated rate equations, energy of activation and determination of order of a reaction based on experimental data
12. Know different types of electrolytes, usefulness of conductance and ionic mobility measurements
13. Determine the transport numbers

Unit - I

Structure and Bonding -I

The ionic bond :Structures of ionic solids Radius ratio rules, Calculation of some limiting radius ratio values, Coordination number 3 (planar triangle), Coordination number 4 (tetrahedral and square planar), Coordination number 6 (octahedral), Close packing. **3hrs**

Classification of ionic structures:

Ionic compounds of the type AX (ZnS, NaCl, CsCl) Ionic compounds of the type AX_2 (Calcium fluoride (fluorite) and Rutile structure Layer structures CdI_2 , Cadmium iodide structure, Limitations of radius ratio concept **2 hrs**

Lattice energy and Born-Haber cycle, Derivation of Born-Lande equation and its drawbacks, Kapustinskii equation, solvation energy and solubility of ionic solids, polarizing power and polarizability, Fajan's rules with applications.

Numerical problems **5 hrs**

Covalent bond: Valence bond theory, The Lewis theory,The octet rule, Exceptions to the octet rule, Sidgwick- Powell theory. Valence shell electron pair repulsion (VSEPR) theory, Effect of lone pairs, electronegativity, isoelectronic principle, Examples using VSEPR theory: BF_3 and BF_4^-, NH_3 and NH_4^+, H_2O, PCl_5, ClF_3, SF_4, I_3^- and I_3^+, SF_6, and IF_7. Limitations of VSEPR. **4 hrs**

Unit - II

Structure and Bonding -II

Concept of resonance, resonance energy, hybridisation, types of hybridization, sp, sp^2, sp^3 dsp^2 dsp^3, d^2sp^3, sp^3d^2 with one example each, and energetics of hybridization. Bent's rule, Limitations of Valence Bond Theory. **3 hrs**

Molecular Orbital theory:

LCAO concept: s-s, s-p, p-p, p-d and d-dcombinations of orbitals, bonding, non -bonding and antibonding molecular orbitals, non-bonding combinations of orbitals,Rules for linear combination of atomic orbitals

Examples of molecular orbital treatment for homonuclear diatomic molecules H2 molecule, H^- He2 molecule, He^+ molecule ion, Li2 molecule, Be2 molecule B2 molecule, C2 molecule, N2 molecule,N_2^+,O_2 molecule, O^- and O_2^{2-}.

M.O. energy diagrams of heteronuclear diatomic molecules with examples (NO, NO^+ CO and HCl). Calculation of bond order, relationship between bond order, bond energy and bond length, magnetic properties based on MOT. **7 hrs**

Metallic Bonding:

General properties of metals : Conductivity, Lustre, Malleability and cohesive force Crystal structures of metals and Bond lengths

Theories of bonding in metals:

Free electron theory,Valence bond theory, Molecular orbital or band theory of solids Prediction of conducting properties of conductors, insulators and semiconductors, extrinsic and intrinsic semiconductors using M.O. theory.

4 hrs

UNIT III

First Law of Thermodynamics

Thermodynamic Processes, Reversible and Irreversible Processes, Nature of Heat and Work, Internal Energy, First Law of Thermodynamics, Enthalpy of a System, Work done in isothermal and adiabatic expansion of an ideal gas, Numerical problems, Joule -Thomson Expansion, Relation between Joule-Thomson coefficient and other thermodynamic parameters.

Second law of Thermodynamics

Concept of entropy, thermodynamic scale of temperature, Statements of the Second Law of Thermodynamics, molecular and statistical interpretation of entropy, Calculation of entropy change for reversible and irreversible processes, Free Energy Functions: Gibbs and Helmholtz energy, Variation of S, G, A with T, V and P, Numerical problems, Free energy change and spontaneity, Gibbs-Helmholtz equation.

Third Lawof Thermodynamics

Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

10 Hrs

Surface Chemistry

Adsorption

Types of adsorption isotherms. Freundlich adsorption isotherm (only equation), its limitations. Langmuir adsorption isotherm (derivation to be done) and BET equation (derivation not included).

Catalysis

Types of Catalysis and theories with examples (intermediate compound theory and adsorption theory), Theory of acid base catalysis, Michaelis-Menten mechanism. Heterogeneous catalysis surface reactions, unimolecular, bimolecular surface reactions. Autocatalysis with examples Applications: Design process to removal of toxic compounds from industrial wastewater and treatment of portable water requirements.

4Hrs

14

UNIT IV

Chemical Kinetics

Differential and integrated form of rate expressions up to second order reactions, Derivation of expression of rate constant of second order reaction (a=b and a ≠ b), Problems on rate constant (a=b), Methods of determination of order of a reaction, temperature dependence of reaction rates; Arrhenius equation, activation energy, Numerical problems on Arrhenius equation in calculating energy of activation and rate constants. Collision theory of reaction rates, Lindemann's mechanism, qualitative treatment of the theory of absolute reaction rates. Experimental determination of kinetics of (i) inversion of cane sugar by polarimetric method (ii) spectrophotometric method for the reaction between potassium persulphate and potassium iodide. **7 Hrs**

Electrochemistry – I

Arrhenius theory of electrolytic dissociation. Merits and Demerits, Conductance, Specific conductance, equivalent and molar conductivity and their variation with dilution. Molar conductivity at infinite dilution. Numerical problems.

Kohlrausch's law of independent migration of ions and its applications, Debye-Hückel- Onsager equation. Ionic mobilities and their determinations, transference numbers and their relation to ionic mobility's, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts (iv) conductometric titrations (acid base titrations only) and (v) Hydrolysis constants of salts. Numerical problems.

7 Hrs

Reference Books

1. Peter Atkins & Julio De Paula, Physical Chemistry, 9th Ed., Oxford University Press (2010)
2. G W Castellan, Physical Chemistry, 4th Ed., Narosa (2004)
3. R G Mortimer, Physical Chemistry 3rd Ed., Elsevier: Noida, UP (2009)
4. B R Puri, L R Sharma and M S Pathania, Principal of Physical Chemistry, Vishal Publishing Co.
5. B S Bahl, G D Tuli and Arun Bahl, Essentials of Physical chemistry, S Chand & Company Ltd.
6. A S Negi and S C Anand, A textbook of Physical Chemistry, New Age International Publishers.
7. B N Bajpai, Advanced Physical chemistry, S Chand and Company ltd.
8. R L Madan, Chemistry for Degree Students, Semester I, II, III and IV, S Chand and Company Ltd.
9. P L Soni, O P Dharmarha and U N Dash, Textbook of Physical Chemistry, Sultan Chand and Sons.

PRACTICALS

Credit Points: 2 **Teaching Hours: 4Hrs**

Evaluation: Continuous Internal Assessment-25 marks

Semester End Examination-25 marks

Course objective:

To attain practical knowledge about:

1. Analytical skills in detecting the constituents present in unknown samples by systematically carrying out the qualitative analysis.
2. The methods of determining rates of chemical reactions.
3. Designing electrochemical cells and making measurement s related to it.
4. Determination of physical characteristics of electrolytes using conductivity measurements in solution.
5. Adsorption phenomenon, mechanism and basic models to explain adsorption.
6. Simple techniques like conductometry to obtain physicochemical parameters of electrolytes.

Course outcomes: At the end of the course student would be able to

1. Understand the chemical reactions involved in the detection of cations and anions.
2. Explain basic principles involved in classification of ions into groups in semi-micro qualitative analysis of salt mixture
3. Carryout the separation of cations into groups and understand the concept of common ion effect.
4. Understand the choice of group reagents used in the analysis.
5. Analyze simple inorganic salt mixture containing two anions and cations
6. Use instruments like conductivity meter to obtain various physicochemical parameters.
7. Apply the theory about chemical kinetics and determine the velocity constants of various reactions.
8. Learn about the reaction mechanisms.
9. Interpret the behavior of interfaces, the phenomena of physisorption and chemisorptions and their applications in chemical and industrial processes.
10. Learn to fit experimental data with theoretical models and interpret the data

Sl No	List of Experiments	Hours
Part A- Inorganic Chemistry Practicals		
1	Qualitative semi-micro analysis of mixtures containing 2 anions and 2 cations. Emphasis should be given to the understanding of different reactions. The following cations and anions are suggested. Cations: NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Al^{3+}, Fe^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Zn^{2+}, Mn^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Mg^{2+}, Na^+, K^+ and Li^+. Anions: CO_3^{2-}, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, SO_4^{2-}, $C_2O_4^{2-}$ and PO_4^{3-}. Spot tests and flame tests to be carried out wherever possible.	28 hrs
Part B- Physical Chemistry Practicals		
1	Determination of the enthalpy of neutralization of a strong acid with strong base.	28 hrs
2	Verification of Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.	
3	The study of kinetics of potassium persulphate and potassium iodide volumetrically	
4	Determination of velocity constant for acid catalyzed hydrolysis of methyl acetate.	
5	Determination of velocity constant for the saponification of ethyl acetate (a = b) volumetrically.	
6	Determination of equivalent conductivity of strong electrolyte and verification of DHO equation.	
7	Determine the critical solution temperature of phenol-water system	
8	Determine the percentage of NaCl solution using solubility of phenol in water	
9	Determine the molecular weight of Non-volatile solute by ebullioscopic method	
10	Study the solubility of benzoic acid in water and determination of H.	
11	Determination of solubility product of sparingly soluble salt conductometrically.	

References:

1. Vogel's Qualitative analysis, Revised by G. Svehla, Pearson education, 2002
2. J B Yadav, Advanced Physical Chemistry, Krishna Prakashan Media (P) Ltd, Meerut, 2014.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi, 2011.
4. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York, 2003.
5. Halpern, A. M. &McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York, 2003.

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B.Sc. Semester IV – Chemistry (Hons): Analytical/ Organic/ Inorganic/ Physical Specialization

Contact Hours: 42 Work load: 3 Hrs/Week. Credit Points: 3

Evaluation: Continuous Internal Assesment-40 Marks

Semester End Examination-60 Marks

Title of the Course: **Open Eelective-4 : Electrochemistry, Corrosion and Metallurgy**

Evaluation Scheme for Theory:

This course provides a broad introduction to the fundamental principles of Electrochemistry, Corrosion and Metallurgy. The student will gain an understanding of basic and practical applications in various fields of Electrochemistry, Corrosion and Metals and Alloy behavior and manufacturing processes. This course is a valuable prerequisite for taking more technically challenging courses that will be required for career development.

Course Objectives

This course will deal with

1. Types of conductance, concept of electrolytes, electrolysis, redox reactions and EMF
2. Concept of different types of electrochemical cells, Types of electrodes and electrode potential. Application of electrochemical series.
3. Basic principles and applications of conductometric, potentiometric and pH titrations.
4. Different types of Batteries their principle construction and working - lead-acid storage and lithium ion battery. Study of Fuels cells.
5. Concept of corrosion, types of corrosion and its prevention by different methods. Introduction to electroplating.
6. Introduction to ores and minerals, extraction of metals from their ores, and purification. Eg., Manganese, Titanium and Uranium.
7. Study of alloys, classification, production and uses of alloys.

Expected Course Outcomes

Upon completion of the course students will be able to

1. Understand the concept of conductance in electrolytic solutions, electrolysis and redox reactions involved in electrode reactions.
2. Learn the different types of electrochemical cells, their symbolical representation and application of electrochemical series.
3. Apply conductometric, potentiometric and pH titrations
4. Know the principle, construction and working of batteries
5. Understand different types of corrosion and its prevention by different methods
6. Learn the methods of extraction of metals from their ores and purification

UNIT I

Electrochemistry

Conductance, specific and molar conductance Types of Electrolytes, Conductivity in electrolytic solution, Electrolysis, Kohlrausch's law and its application, Equivalent Conductance of Weak electrolyte at Infinite dilution.

Oxidation -reduction reactions, electrode potential, EMF of an electrochemical cell, cell reaction, Daniel cell, dry Cells - electrolytic and Galvanic cell, Representation of a cell. Standard electrode potential, Nernst equation (No derivation) and its application to chemical cell, electrochemical series and its importance. Types of Electrodes.

Basic Principles of (i) Conductometric titrations- HCl Vs NaOH, CH_3COOH Vs NaOH
(ii) Potentiometric titrations: Acid-base titration HCl Vs NaOH, Redox titration (FAS Vs $K_2Cr_2O_7$)

Determination of P^H using glass electrode. **12 hrs**

Batteries- Primary and Secondary batteries, Battery components and their role. Working of the following Batteries- Lead acid, Lithium Storage, Batteries, Fuel cells. **2 hrs**

UNIT II

Corrosion: Introduction, definition, Types of Corrosion, Corrosion rate, Factors affecting corrosion rate, Metallic factor-purity, electrode potential of metal, hydrogen over voltage, nature of corrosion product. Environmental Factors-Temperature, pH of the medium, humidity, presence of impurities, electrical conductivity of the medium, velocity of the medium, concentration of the medium.

Prevention of Corrosion: Material selection - Metals and alloys, metal purification, non-metallic, Alteration of environment - Changing media, inhibitors, Design-wall thickness, design rules, Coating-Metallic and other inorganic coatings, organic coating.

Electroplating: Introduction, Electroplating of chromium (hard and decorative). Electro less plating: Introduction, distinction between electroplating and electroless plating processes. **14 hrs**
Electroless plating of copper.

UNIT III

Metallurgy

Introduction: Ore, minerals, important ores of some common elements in India, General Principles of pyrometallurgy, roasting, Calcination, Gangue, Smelting, Flux, Gravity separation, Froth flotation process, leaching. Techniques employed for Purification of metal (Distillation process, Bessemerization, Electro-refining, Van Arkel and De Boer's Filament. **6 hrs**

Extraction of metals: Extraction of Manganese (Pyrolusite), Titanium (Ilmanite) and Uranium. **4 hrs**

Alloys: Introduction, Classification of alloys, commercially important alloys, gold karats, Production of Ferro alloys; Ferrochrome, Ferro Manganese, Uses of alloys. **4 hrs**

Reference Books

1. Barrow. G.M, Physical Chemistry, Tata McGraw-Hill, (2007)
2. An introduction to electrochemistry, Samuel Glasstone, East-West edition New Delhi, (1942)
3. Text book of physical chemistry, Samuel Glasstone, 2nd Edition, Mac Millan India Ltd, (1991)
4. Principles and applications of Electrochemistry, D. R. Crow, 3rd edition, Chapmanhall London, (1988)
5. Fundamentals of electrochemical deposition, Milan Paunovic and Mordechay Schlesinger, Wiley Interscience Publications, New York, (1998)
6. Engineering Chemistry, V R Kulkarni and K Ramakrishna Reddy, New Age International, (2015)
7. Electrochemistry and Corrosion Science, Nestor Perez, Springer (india) Pvt. Ltd., (2004)
8. Principles and Prevention of Corrosion, D. A. Jones, Macmillan Publ. Co., (1996)
9. Essential of Materials Science and Engineering, Donald R. Askeland, Thomson Learning, 5th Edition, (2006)
10. Introduction to Engineering Materials, B. K. Agarwal, Tata McGraw Hill, 1st Edition
11. Material Science and Engineering, V. Raghavan, PHI Learning, 5th Edition
12. Engineering Materials and Metallurgy, R. K. Rajput, S. Chand - 1st Edition, (2011)

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Scheme of Evaluation of UG Practicals

Total Marks for Practical End Semester Examination: 25Marks
Duration of Examination: 03 hrs
One experiment may be conducted for the end semester examination
Scheme of Marks distribution:

1) Execution of the Experiment: 15 marks
   (Includes design, execution, graph, calculation and reporting
   (Including observation)
2) Mechanism/Accuracy/Chemical Reaction/Interpretation of the Results 05 marks
3) Viva-Voce 05 marks

Total **25 Marks**

HEAD OF DEPARTMENT
DEPARTMENT OF CHEMISTRY
Govt. College (Autonomous)
KALABURAGI

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Government of Karnataka
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Phone: 08472-245064 (Re-Accredited by NACC with "B" Grade) www.gcak.ac.in

Ref No.: GCK(AI)/BOS(UG)/2023-24/ Date : 05/10/2023

OFFICE ORDER

Subject : Appointment of members of Board of Studies (UG)

Reference: 1. UGC Revised Guidelines for Autonomous Colleges dt. : 19.01.2018

2. Registrar, GUK Letter No. ಗುವಿಕ/ಬಿಮಬಿ/ಜಿಎಸ್/2017-18/2547 Dated 24.01.2018

3. Resolution of the DC meeting held on 05/10/2023

Advert to the cited subject and references, the Board of Studies (UG) have been constituted as shown below.

BOARD OF STUDIES (UG) IN CHEMISTRY

Sl No.	Name of the Members	Designation	Address with Phone No & Email	Appointed as
1	**Dr. Vijayanand Vithalrao** Associate Professor	Asso. Prof.	v_havanoor@ rediffmail.com	Chairman
2	**Prof. Beede Suneelkumar** Associate Professor	Asso. Prof.	naguyogi_beede@ rediffmail.com 8310857363	Member
4	**Dr. Mahadev U** Assistant Professor	Assis. Prof.	mahadev510@gmail.com 8310258620	Member
5	**Prof. Roopa Kulkarni** Assistant Professor	Assis. Prof.	shrishk.rk@gmail.com 9886200282	Member
6	**Dr. Vaman Gajre** Associative Professor, Govt. First Grade College Sedam, Dist. Kalaburagi	Asso. Prof.	vamangajre66@ gmail.com 9916952204	External Member (other than parent University)
7	**Dr. Dhondiba Vishwanath** Associative Professor, Govt. First Grade College Womens Kalaburagi.	Asso. Prof.	dhondibavishsurya123 @gmail.com	External Member (other than parent University)
8	**Prof. Anand Soundane,** Professor and Chairman Department of P. G. Studies and Research in Chemistry Gulbarga University, Kalaburgi-06	Professor	arsaundane @ rediffmail.com 9480272325	University Nominee
9	**Devendra Lingappa** Priyanka agro tech. Plot No.124,kapnoor Indl. area, Humnabad road, Kalaburgi	Industrialist Representative	devendralingappa8 @gmail.com 9141363430	External Member representing Industry
10	**Dr. Vijayakumar Salimani** Assistant Professor Department of studies in History, Government College (Autonomous) Kalaburagi-577002	Asso. Prof.	drvijayanand410@ gmail.com 9902485607	Alumni Member

The term of nominated members shall be 03 years from the date of this Order.

Copy to:

1. Chairman, Board of Studies (UG) in CHEMISTRY
2. All the members of the BOS
3. Academic Dean (UG) Govt. College (Autonomous), Kalaburagi
4. Office Copy.

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Ref No.: GCK(AI)/BOS(UG)/2023-24/ Date : 05/10/2023

BOARD OF STUDIES (UG) IN CHEMISTRY

Sl No.	Name of the Members	Responsibilities	Address with Phone No & Email	Signature
1	**Dr. Vijayanand Vithalrao** Associate Professor	Chairman	v_havanoor@ rediffmail.com	
2	**Prof. Beede Suneelkumar** Associate Professor	Member	naguyogi_beede@ rediffmail.com 8310857363	
4	**Dr. Mahadev U** Assistant Professor	Member	mahadev510@gmail.com 8310258620	
5	**Prof. Roopa Kulkarni** Assistant Professor	Member	shrishk.rk@gmail.com 9886200282	
7	**Dr. Vaman Gajre** Associative Professor, Govt. First Grade College Sedam, Dist. Kalaburagi	External	vamangajre66@ gmail.com 9916952204	
8	**Dr. Dhondiba Vishwanath** Associative Professor, Govt. First Grade College Womens Kalaburagi.	External Member	dhondibavishsurya123 @gmail.com	
9	**Prof. Anand Soundane,** Professor and Chairman Department of P. G. Studies and Research in Chemistry Gulbarga University, Kalaburgi-06	University Nominee	arsaundane @ rediffmail.com 9480272325	
10	**Devendra Lingappa** Priyanka agro tech. Plot No.124,kapnoor Indl. area, Humnabad road, Kalaburgi	Industrial Representative	devendralingappa8 @gmail.com 9141363430	
11	**Dr. Vijayakumar Salimani** Assistant Professor Department of studies in History, Government College (Autonomous) Kalaburagi-577002	Alumini Member	drvijayanand410@ gmail.com 9902485607	

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DEPARTMENT OF CHEMISTRY

DATE: 17-10-2023

To
The Dean (UG)
Academic Section
Government College (Autonomous)
KALABURGI

Dear Sir,

Sub: Submission of BOS Approved Syllabus under NEP Scheme
Ref: 1.BOS Meeting and Proceeding dated: **17-10-2023**

With reference to the above subject, I am submitting the BOS approved complete syllabus of B.Sc. (NEP) curriculum (Semester V and VI) of Chemistry as per State committee

The Departmental meeting on the NEP UG-Chemistry syllabus was followed by the BOS meeting. The syllabus which was drafted as per the suggestions of the BOS has subsequently approved by the BOS along with practical examination scheme.

Thanking You

Your's sincerely,

Head of the department

Enclosures
1. Signed BOS Formats and approved syllabus of BSC-V & VI Semester
2. BOS Proceeding copy

Government of Karnataka
DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Sedam Road, Kalaburagi-585 105
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DATE: 05-10-2023

To
The Dean (UG)
Academic Section
Government College (Autonomous)
KALABURGI

Dear Sir,

Sub: Submission of UG-NEP Syllabus of Chemistry

This is to bring to your kind notice that the board of studies meeting conducted on **05-10-2023** has accepted and decided to keep the syllabus of UG Chemistry as formulated by state committee of (NEP).

However, UG — NEP Syllabus for Chemistry was implemented in the year of 2023-24 in the Department of Chemistry.

Hence, the NEP Syllabus is being submitted for your perusal

Thanking you,

Your's sincerely,

Head of the Department

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PROCEEDINGS OF THE BOARD OF STUDIES IN CHEMISTRY (UG)

The meeting of the Board of studies (UG) in Chemistry for the academic year **2023-24** was held on **17-10-2023** at **10.30** AM in the department of Chemistry, Government College, Kalaburgi (an autonomous institution). The committee discussed on draft syllabus (revision/new) of undergraduate courses of Chemistry of B.Sc V & VI semester of **NEP, (DSC-V and DSC-VI)** and approved as below.

Semester	Theory code	Hrs/ Week	Credits	Practicals code	Hrs/Week	Credits	Total Credits per Semester
V	DSC-9 DSC-11	4 4	4 4	DSC-10 DSC-12	4 4	2 2	12
	Major- 2						12
	Internship	3	2				2
Total							26
VI	DSC-13 DSC-15	4 4	4 4	DSC-14 DSC-16	4 4	2 2	12 12
	Cyber Security or Employability Skills	4	3				3/2
Total							27/26
Total Credits : V - VI SEMESTER (27 + 26 = 53)							

Theory and Practicals (B.Sc. in Chemistry V Semester)

DSC - 09 : Selected Topics in Inorganic Chemistry- III
DSC- 10 : Inorganic Chemistry Practical
DSC - 11 : Selected Topics in Organic Chemistry- III
DSC- 12 : Organic Chemistry Practicals

Theory and Practicals (B.Sc. in Chemistry VI Semester)

DSC - 13 : Selected Topics in Physical Chemistry- III
DSC - 14 : Physical Chemistry Practicals
DSC - 15 : Spectroscopy
DSC- 16 : Analytical and Industrial Chemistry Practicals

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DEPARTMENT OF CHEMISTRY

B.SC. CHEMISTRY V AND VI SEMESTER SYLLABUS-2023-24 (NEP)

Sem.	Type of Course	Course Title	Instruction hour/week	Total hours / sem.	Duration of Exam	Formative	Summative	Total	Credits
V	DSC-9	Inorganic Chemistry (Theory)-IX	04hrs	60hrs	02hrs	40	60	100	04
	DSC-10	Inorganic Chemistry (Practical)-X	04hrs	60hrs	03hrs	25	25	50	02
	DSC-11	Organic Chemistry (Theory)-XI	04hrs	60hrs	02hrs	40	60	100	04
	DSC-12	Organic Chemistry (Practical)-XII	04hrs	60hrs	03hrs	25	25	50	02
	Other subject								
	Other subject								
	Other subject								
	Internship-1	Chemistry Internship	04 hrs	00	02 hrs	25	25	50	2
	Total								14
VI	DSC-13	Physical Chemistry (Theory)-XIII	04hrs	60hrs	02hrs	40	60	100	04
	DSC-14	Physical Chemistry (Practical)-XIV	04hrs	60hrs	03hrs	25	25	50	02
	DSC-15	Spectroscopy (Theory)- XV	04hrs	60hrs	02hrs	40	60	100	04
	DSC-16	Analytical and Industrial Chemistry Practical (Practical)-XVI	04hrs	60hrs	03hrs	25	25	50	02
	Other subject								
	Other subject								
	Other subject								
	SEC-3	Employability skills in Chemistry / Cyber Security	04 hrs	60hrs	3/2 hrs	25	25	50	3/2
	Total								15/14

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DEPARTMENT OF CHEMISTRY

Programme Specific Outcomes (PSO):

On completion of the 03 years Degree in Chemistry students will be able to:

- Demonstrate, solve and understand the major concepts in all the disciplines of chemistry.
- Provide students with broad and balanced knowledge and understanding of key chemical concepts.
- Understand practical skills so that they can understand and assess risks and work safely and competently in the laboratory.
- To apply standard methodology to the solutions of problems in chemistry.
- Provide students will knowledge and skill towards employment or higher education in chemistry or multi-disciplinary areas involving chemistry.
- Provide students with the ability to plan and carry and experiments independently and assess the significance of outcomes.
- Develop in students the ability to adapt and apply methodology to the solution of unfamiliar types of problems.
- Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of chemical reactions.
- To prepare students effectively for professional employment or doctoral degrees in chemical sciences.
- To career to the demands of chemical industries of well-trained graduates.
- To build confidence in the candidate to be able to work on his own in industry and institution of higher education.
- To develop an independent and responsible work ethics.

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The committee also approved the syllabus of above course.

To approve the Pattern of Question Paper DSCT.

It is resolved to adopt the following pattern of question paper.

Scheme of Examination:

1) There shall be one question paper each for B.Sc. Vth and VIth semester in Chemistry.
2) In addition, there shall be Practical Examinations as per the Autonomous Regulations existing from time to time.

Question paper pattern:
Each question paper shall contain three section (**Section-A, Section-B and Section-C**) & Minimum **ONE** question from each unit should be taken.

Vth and VIth Sem. DSC-5 and DSC-6:
Section-A: (05 × 02 = 10 Marks) – Two marks **Seven** questions given, candidates has to answer any **five** questions.
Section-B: (04 × 05 = 20 Marks) – Five marks **Six** questions given, candidates has to answer any **four** questions.
Section-C: (03 × 10 = 30 Marks) – Ten marks **Five** questions given, candidates has to answer any **three** questions.

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DEPARTMENT OF CHEMISTRY

B.Sc. Chemistry V & VI Semester Syllabus - 2023-2024 (NEP) B.Sc. Course Pattern and Scheme of Examination under NEP approved by UG-BOS in Chemistry held on 25-09-2023

Course Pattern: B.Sc. Chemistry V & VI Semester Syllabus

Semester	Theory code	Hrs/Week	Credits	Practicals code	Hrs/Week	Credits	Total Credits per Semester
V	DSC-9 DSC-11	4 4	4 4	DSC-10 DSC-12	4 4	2 2	12
	Major- 2						12
	Internship	3	2				2
						Total	26
VI	DSC-13 DSC-15	4 4	4 4	DSC-14 DSC-16	4 4	2 2	12 12
	Major- 2						24
	Cyber Security or Employability Skills	4	3				3/2
						Total	27/26
Total Credits : V - VI SEMESTER (27 + 26 = 53)							

Theory and Practicals (B.Sc. in Chemistry V Semester)

DSC -09 : Selected Topics in Inorganic Chemistry- III
DSC -10 : Inorganic Chemistry Practical
DSC -11 : Selected Topics in Organic Chemistry- III
DSC -12 : Organic Chemistry Practicals

Theory and Practicals (B.Sc. in Chemistry VI Semester)

DSC -13: Selected Topics in Physical Chemistry- III
DSC -14: Physical Chemistry Practicals
DSC -15: Spectroscopy
DSC -16: Analytical and Industrial Chemistry Practicals

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GOVERNMENT COLLEGE, KALABURAGI
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DEPARTMENT OF CHEMISTRY

B.Sc. Chemistry V & VI Semester Syllabus - 2023-2024 (NEP) B.Sc. Course Pattern and Scheme of Examination under NEP approved by UG-BOS in Chemistry held on 25-09-2023

DISCIPLINE CORE COURSE: SEMESTER – V

DSC-9: Selected Topics in Inorganic Chemistry-III: **Theory-60 hours**

UNIT-I: **15 hours**

Chemical Bonding- VSEPR model, shapes of molecules; ICLT, TeF_5^-, XeF_6, ReF_7, XeF_5^{2-}, Bent rules and energetics of hybridization; electronegativity and partial ionic character; Bonds- Multicenter, Synergic and Agostic bonding. Lattice energy: Born-Lande equation, Kapustinskii equation; polarizability and partial covalent character, radius-ratio rules, structures of simple solids, Zintl-isoelectronic relationship in solids. Molecular orbital theory: LCAO and MO diagrams of heteronuclear diatomic (CO, NO, HF, IC1) and triatomic molecules (CO_2 and NO_2).

UNIT-II: **15 hours**

Chemistry of main group elements-Structure and bonding in boranes, carboranes, metallocarboranes, Wades rules, borazines, phosphazenes, S,N-compounds. Silicates-Classification, structures, isomorphous replacement, pyroxenes, layered and vitreous silicates, zeolites and molecular sieves. HSAB concept: Basis of HSAB concept, acid-base strength, hardness and softness, symbiosis, applications of HSAB concept; Acid- base concept in non-aqueous media, reactions in BrF_3, N_2O_4, anhydrous H_2SO_4, CH_3COOH. Isopoly and heteropoly acids of W, Mo and V, preparations, properties, structure and applications.

Stereoisomerism – Chirality, optical activity – CD, ORD, Catton effect, absolute configuration of metal complexes, magnetic circular dichroism.

UNIT-III: **15 hours**

M-M bond and metal atom clusters, halide clusters, bonding in $[ReCls]^{2n}$. Metal carbonyl clusters-LNCC's and HNCC's. Electron counting in carbonyl clusters, Wades-Mingos and Lauher rules. Nuclear Chemistry-The atomic nucleus-elementary particles, quarks, classification of nuclides based on Z and N values, nuclear stability, nuclear potential, binding energy. Nuclear Models: Shell model-salient features, forms of the nuclear potential, filling of orbitals, nuclear configuration, Liquid drop model, Fermi gas model, Collective model and Optical model. Radioactivity, radioactive decay kinetics, Parent-daughter decay-growth relationship-secular and transient equilibria, theories of a, (3 , (3$^+$ and y-decay, internal conversion, Auger effect.

UNIT-IV: **15 Hours**

Co-ordination Chemistry: Double salts, complex salts, definition of terms-complex ion, ligand, co-ordination number, coordination sphere. Types of ligands with example-monodentate, bidentate, polydentate, Ambidentate and macro cyclic ligands (crown ethers, porphyrins). Methods of detection of complex formation- conductivity, pH, colour, EAN rule for stabilizing of complexes. Nomenclature of complex compounds. Isomerism in complex compounds: a) Structural isomerism-Ionization isomerism, hydrate isomerism, linkage isomerism and coordinate isomerism, b) Optical and geometrical isomerism in complex compounds with coordination number 4 and 6.

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9. Halicavadi

Applications of complex formation in (a) Metallurgy (in the extraction of nickel and gold) (b) Qualitative and quantitative analysis.

Valance Bond Theory (VBT): Valence bond theory as applied to complexes- inner and outer orbital complexes. The structure and geometry of the following complexes to be discussed: $[Fe(CN)_6]^{3-}$, $[Fe(H_2O)_6]^{2+}$, $[MnCl_4]^{2-}$ $[Ni(CO)_4]^{2+}$, $[Cu(NH_3))_4]^{2+}$.

Modification of VBT: Electroneutrality principle of $[Be(H_2O)]^{2+}$ and back bonding effect with respect to $[Ni(CO)_4]^{2-}$.

Crystal Field Theory (CFT): Splitting of d-orbitals in octahedral and tetrahedral fields, effect of weak and strong field ligands, spectrochemical series of ligands, crystal field stabilization energy and calculation of CFSE for different systems.

Formative assessment for theory	Marks
Assessment type	
Internal Assessment Test- 1	15
Internal Assessment Test- 2	15
Assignment/ Small project	05
Assignment	05
Total	40 Marks
Formative Assessment as per guidelines	

B.Sc. Semester-V

DisciplineSpecific Course (DSC)-10

Course Title: Inorganic Chemistry Practical:

Type of course	Theory/ Practical	Credits	Instructions Hour per week	Total No. of Lectures/hours semester	Duration of exam	Formative Assessment	Summative assessment	Total
DSC-10	**Practicals**	**02**	**04**	**60**	**02**	**25**	**25**	**50**

Course Outcomes:

At the end of the course, students will be able perform the various steps involved in the gravimetric analysis of metal ions and preparation of co-ordination complexes.

DSC-10: INORGANIC CHEMISTRY PRACTICALS

PART-A: Gravimetric and Volumetric Analysis

1. Gravimetric determination of Fe in iron ore as Fe_2O_3.
2. Gravimetric estimation of calcium as calcium oxide.
3. Gravimetric estimation of aluminum as aluminum oxide.
4. Gravimetric estimation of magnesium as magnesium-oxinate.
5. Gravimetric determination of Ni using DMG in Cu and Ni solution.
6. Gravimetric determination of Fe using NH_4OH in Fe and Cr solution.
7. Gravimetric estimation of Cu using NH_4SCN in Cu and Zn solution.
8. Volumetric estimation of Ca and Mg in dolomite solution.
9. Volumetric estimation of Fe in Cu and Fe solution.

PART-B: Preparation of co-ordination complexes

1. Preparation of hexamminenickel(III) chloride.
2. Preparation of chloropentaminecobalt(III)chloride.
3. Preparation of tris(oxalato)ferrate(III).
4. Preparation of hexamminecobalt (III)chloride(demonstration).
5. Preparation of mercury tetrathiocyantocobaltate(II) (demonstration).
6. Preparation of trans-potassium diaquadioxalatochromate (III).
7. Preparation of tris(thiourea) copper (I) sulphate monohydrate

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8. Preparation of pentamminechlorocobalt (III) chloride.

References:

1. Advanced Inorganic Chemistry, 6th edition; F.A. Cotton and G. Wilkinson.
2. Inorganic Chemistry IV edition; J.E. Huheey, E.A. Keiter and R. L. Keiter, Addison; Wesley (1993).
3. Inorganic Chemistry, II edition, D.F. Shriver, P.W. Atkins and C.H. Langford, ELBS; Oxford University Press, 1994.
4. Chemistry of elements; N.N. Greenwood and A.E. Earnshaw, Butterworth Heinemann (1997).
5. Concise Inorganic Chemistry, 5th edition; J.D. Lee (1996).
6. Essentials of nuclear chemistry, 4th edition; H.J. Arniker, NAIL publishers (1995).
7. Nuclear and Radioactive chemistry; Friedlander, Kennedy and Miller.
8. Inorganic Chemistry, 3rd Edition; Gary. L. Miessler and Donald. A. Tarr (2007).
9. Principles of Inorganic Chemistry (UGC Syllabus), B.R. Puri, L.R. Sharma, K.C. Kalia, Milestone Publishers, New Delhi, India, 2008.
10. Advanced Inorganic Chemistry by Gurudeep Raj and Chatwal Anand.
11. Modern Inorganic Chemistry by R.D. Madan.
12. Advanced Inorganic Chemistry by Sathyaprakash.

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Note: The list of experiments is suggestive. However, faculties / academic bodies may add more experiments / references or incorporate suitable revisions based on infrastructure facilities available at the Institution.

DSC-11: Selected Topics in Organic Chemistry-III: Theory-60 hours

UNIT-I: **15 hours**

Alcohols: **(8 hours)**

Monohydric alcohol:- Classification, nomenclature, preparation from alky halides, aldehydes, ketones. Distinguish test between 1°, 2°, 3° alcohols by Victor-Meyer method, Lucas method. Test for hydroxyl alcohol- formation of alkoxide, esterification with mechanism, oxidation.

Dihydric alcohol:- Nomenclature, preparation of glycol from alkene. Oxidative cleavage using lead tetra acetate, periodic acid.Uses of ethylene glycol.

Trihydric alcohol:- Nomenclature, manufacture of glycol from Spent lye. Synthesis from propene. Reactions of glycol with oxalic acid at different temperatures, reaction with PCl_5, with fatty acids. Uses of glycerol.

Phenols: **(7 hours)**

Classification, nomenclature, Methods of preparation from Cumene, Dow process, from diazonium salts.Acidity of phenols- resonance, stabilization of phenoxide ion, compare the acidity of alcohol and phenol. Effect of substituent's on acidity of phenols, electron withdrawing groups ($-NO_2$, -Cl, -CN, -CHO, -COOH), electron donating groups ($-CH_3$, $-OCH_3$, $-NH_2$). Reactions of phenols. Fries, Claisen, Reimerr-Tiemann, reactions with mechanism. Synthesis of phenolphthalein, salicylaldehyde, vanillin, o-benzoquinone.

Unit-II: **15 hours**

Aldehydes and Ketones: **(5 hours)**

Nomenclature. Structure and reactivity of carbonyl groups in aldehydes, ketones. Reactions of aldehydes and ketones with hydroxyl amine, hydrogen cyanide, 2,4-DNP. Reaction Mechanism of Aldol, Perkin's, Benzoin, Cannizaro, Knoevenagel reaction. Clemmenson reduction, Wolff-Kishner reduction.

Rearrangements: **(5 hours)**

Wolff, Hofmann, Curtius, Lossen and Schmidt rearrangements. Benzil-benzilic acid rearrangement. Stevens, Wittig and Favorskii rearrangements, Baeyer-Villiger oxidation. Neberre arrangement. Benzidine rearrangement.

Amino acids and proteins: **(5 hours)**

Definitions and classification of amino acids, synthesis of amino acids by Gabriel phthalimide, malonic ester and Strecker's method of synthesis. Properties and reactions- Zwitter ion and isoelectric points. Ninhydrin and Biuret tests.

Peptides: peptide bond, carbobenzoxy method of synthesis of peptides.

Proteins: Classification based on composition and structure: primary and secondary structures of proteins. Denaturation of proteins.

UNIT-III: **15 hours**

Stereochemistry: **6 hours)**

Walden inversion, asymmetric synthesis.Geometrical isomerism: Geometric isomerism in maleic acid and fumaric acid. Determination of their configurations. Geometrical isomerism of oximes, Determination of configuration of oximes. Beckmann rearrangement.

Conformational analysis: Conformational analysis of Ethane, Propane, Butane, cyclohexane substituted cyclohexanes, (Mono and di- 1,1- 1,2- 1,3- and1 ,4-).

Carbohydrates: **(6 hours)**

Introduction, Kiliani-Fischer synthesis, Determination of configuration of the monosaccharides, conformational analysis of monosaccharides. Synthesis of amino sugars ((3-D-Glucosamine, galactosamine, N-acetylmuramic acid (NAMA), N-acetylneuraminic acid NANA). C-and N-glycosides. Synthesis of aldonic, uronic, aldaric acids and alditols. Structure elucidation of sucrose and maltose. Structures of lactose, gentiobiose, and meliobiose. Photosynthesis of carbohydrates.

Retrosynthesis: **(3 hours)**

General terms: synthon, synthetic equivalents and target molecule. General guidelines for disconnection, Disconnection approach, Retrosynthesis of benzocaine, 4-methoxy acetophenone, saccharin.

Unit-IV: **15 hours**

Heterocyclic compounds:

Nomenclature of heterocyclic compounds. Aromaticity of pyrrole, furan, thiophene. Basicity of pyrrole and pyridine. Preparation (Any two methods) and reactions (any three) of pyrrole, furan, thiophene, indole, pyridine, quinoline, isoquinoline.

Structure, reactivity, synthesis (any two methods) and reactions (any two) of pyrazole, imidazole, oxazole, isoxazole, thiazole, isothiazole, pyrimidine, purine. Preparation and reactions of coumarins, acridines, cinnolenes and quinoxalines.

Formative assessment for theory	Marks
Assessment type	
Internal Assessment Test- 1	15
Internal Assessment Test- 2	15
Assignment/ Small project	05
Assignment	05
Total	40 Marks
Formative Assessment as per guidelines	

B.Sc. Semester-V

DisciplineSpecific Course (DSC)-12

Course Title: Organic Chemistry Practical:

Type of course	Theory/ Practical	Credits	Instructions Hour per week	Total No. of Lectures/hours semester	Duration of exam	Formative Assessment	Summative assessment	Total
DSC-12	**Practicals**	**02**	**04**	**60**	**02**	**25**	**25**	**50**

Course Outcomes:

At end of the course, students will be able to:

1. Learn the skills of the preparation of organic compounds.
2. Acquire the knowledge of Analysis of mixtures

DSC-12 : ORGANIC CHEMISTRY PRACTICALS

PART-A : Preparation (one stage)

1. Cannizarroreaction: Benzaldehyde.
2. Friesrearrangement: Phenylacetate.
3. Friedel-Craftsreaction: Benzeneand Acetylchloride.
4. Sandmeyerreaction: 4-Chlorotoluene from 4-toluidine.
5. Pechmannreaction: Resorcinol and ethylacetoacetate.
6. Oxidation of Cyclohexanol.
7. Preparation of S-Benzylisothiuronium chloride.
8. Synthesis of p-iodonitrobenzene
9. Synthesis of N-Phenyl-2,4-dinitroaniline.
10. Synthesis of 2,4,6-tribromoaniline.
11. Synthesis of 2,4-dichlorophenoxy acetic acid.

PART-B:

Organic Qualitative analysis of binary mixture containing two solid compounds, separation using NaHCO3, NaOH and HCl. Identification, separation of mixture and analysis of any one component

Acids- Benzoic, Salicylic, cinnamic and Phthalic acid.
Phenols- 1-Napthol, 2-Napthol and Resorcinol
Bases- P-toluidine, O-toluidine, m-toluidine, N-anilines.
Neutrals- Naptholene, Diphenyl, m-Dinitrobenzene, Acetanilide
The mixture is of A+B, A+N, P+B, P+N and B+N

References:

1. Advanced Organic Chemistry- Reactions, Mechanism and Structure, Jerry March, JohnWiley (2008).
2. Advanced Organic Chemistry, FA Carey and RJ Sundberg Plenum,(1990).
3. A Guide Book to Mechanismin Organic Chemistry, Peter Sykes, Longman, (2000).
4. Structure and mechanism of Organic Chemistry, CK Ingold, Cornell University Press (1999).
5. Organic Chemistry, RT Morrison and RN Boyd, Prentice-Hall, (1998).
6. Modern Organic Reactions, HO House, Benjamin, (1972).
7. Principles of Organic Synthesis, ROC Norman and JM Coxon, Blackie Academic and Professional, (1996).
8. Stereochemistry of Organic Compounds, D Nasipuri, New-Age International, (1999).
9. Stereochemistry of Carbon Compounds, ELEliel, SH Wilenand LN Mander, JohnWiley, (1994).
10. Stereochemistry,Potapov, MIR, Moscow, 1984.
11. Organic Chemistry, Volumes I and II, IL Finar, Longman,(1999).
12. Organic Chemistry, Bahl and ArunBahl, S. Chand and Sons, New Delhi, 2005.
13. Organic Chemistry, R. T. Morrison and R. N. Boyd, VI Edition, Printice-Hall of India Limited, New Delhi, 1992.
14. Organic Chemistry, B. Y. Paula, III Edition, Pearson Education, Inc.(Singapore), New Delhi, reprint, 2002.
15. Textbook of Organic Chemistry, P S Kalsi, Mac Millan, 2000.

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Note: The list of experiments is suggestive. However, faculties / academic bodies may add more experiments / references or incorporate suitable revisions based on infrastructure facilities available at the Institution.

DISCIPLINE CORE COURSE : SEMESTER - VI

DSC-13: Selected Topics in Physical Chemistry-III: **Theory-60 hours**

Unit-I: **15 hours**

Electrochemistry-II: **(6 hours)**

Definition of EMF of a cell, standard electrode potential, IUPAC sign convention; Types of reversible electrodes with examples: gas-metal ion, metal-ion, metal insoluble salt-anion electrode, Redox electrode with examples - Quinhydrone electrode (To be mentioned).

Reference electrodes - Construction and working of SHE and calomel electrode. Concentration cell -Derivation of EMF using Nernst equation for electrolytic concentration cell without transference. Liquid junction potentials, elimination of liquid junction potential. Potentiometric titration involving only redox systems ($K_2Cr_2O_7$ vs FAS).

Quantum Mechanics: **(9 hours)**

Physical interpretation of the wave function. Operators: Laplacian, Hamiltonian. Angular Momentum operators and their properties. Postulates of quantum mechanics, Schrodinger wave equation based on the postulates of quantum mechanics and its importance. Concepts of solutions of Schrodinger wave equation for a Particle in a one dimensional box, particle in a three-dimensional box. Quantum mechanical degeneracy, tunneling (no derivation). Application of Schrodinger equation to harmonic oscillator, rigid rotator. Eigen functions and eigen values of angular momentum. Schrodinger equation to hydrogen atom in spherical polar co-ordinates. Total wave functions of hydrogen atom. Quantum numbers and their characteristics. List of wave functions for few initial states of hydrogen like atoms.

UNIT-II: **15 hours**

Chemical Dynamics-I

Review of theories of reaction rate-Collision theory and Transition state theory, Comparison of collision theory with transition state theory, Arrhenious equation-characteristics, Significance of energy of activation, Temperature coefficient and its evaluation. Thermodynamical formulation of reaction rates, (Eyring treatment), Reaction between ions in solutions - Influence of ionic strength on reaction rates (primary and secondary salt effects). **Concept of Steady state kinetics,** Chain reactions - chain length and chain inhibition, comparison of photochemical and thermal reactions, Mechanisms of thermal and photochemical reactions between hydrogen-bromine and hydrogen-chlorine. Comparative study of thermal and photochemical hydrogen-halogen reactions. Pyrolysis of acetaldehyde, Decomposition of ethane.

Kinetics of fast reactions- Introduction, Study of reactions by relaxation method (Temperature and pressure jump), flow method (Plug flow method and Stopped flow method), Flash photolysis and Shock tube method.

UNIT-III: **15 hours**

Surface chemistry

Adsorption: Effect of temperature on adsorption, Mechanism of adsorption, Derivation of BET equation, Estimation of surface area using BET equation, Gibbs adsorption isotherm and its significance, Surface tension and surface energy, Pressure difference across curved surface (Laplace equation), Vapour pressure of droplets (Kelvin equation), Surface film on liquids (electro-kinetic phenomena), Catalytic activity of surfaces.

Photochemistry:

Characteristics of electromagnetic radiation, Lambart-Beer's and its limitation, physical significance of absorption coefficients. Laws of photochemistry, Grotthu-draper law, Stark-Einstein law statements,differences between photophysicaland photochemical processes-any four differences with examples.

Comparsion of photochemical and thermal reaction withan example each. Quantum yield definition.

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Magnetude of quantum yield of photochemical combinations of (i) H2 (ii) Cl2 and Br2 (iii) dissociation of HI (iv) dimerization of anthracene: reason for low high and medium quantum yield. Photosensitization-definition with example, photo stationary equilibrium definition and example. Singlet and triplet states-definition. Fluorescence, phosphorescence, luminescence, bioluminescence and chemical sensors-definition of all these with suitable examples.

UNIT-IV: **15 hours**

Thermodynamics: Third law of thermodynamics. Entropy of vapourisation, limitations of Van't Hoff s equation. Concept of chemical potential, variation of chemical potential with temperature and pressure, derivation of Gibbs-Duhem equation, Duhem-Margules equation and its application.

Phase Rule: Derivation of phase rule from the concept of chemical potential. Application of Phase Rule to three components system: Principle of triangular diagram: Plots for a mixture of three liquids consisting of one, two and three pairs of partially miscible liquids.

Statistical Thermodynamics: Energy states: macro and microstates, Limitation of classical thermodynamics, Distinguish between classical mechanics and statistical mechanics. derivation of Maxwell-Boltzmann statistics, statistical interpretation of entropy, application of statistics to gases-monoatomic ideal gas (No derivations). Partition functions and thermodynamic parameters, expressions for translational, rotational, vibrational and electronic partition functions, enthalpy, energy, Gibbs free energy.

Partition functions: Definition and significance, molar and molecular partition functions, Derivation of expression of partition function for rotational, vibrational, electronic, and translational motion. Relation between equilibrium constant and partition function.

References:

1. Physical Chemistry, P.W. Atkins, Juliode Paula, ELBS, 7th edition, (2002).
2. Physical Chemistry: A Molecular Approach, McQuarie and Simon, Viva, New Delhi, (2001).
3. Introduction to Quantum Chemistry, A.K. Chandra,Tata McGraw Hill, (1988).
4. Quantum Chemistry, Ira. N. Levine, Prentice Hall, New Jersey, (1991).
5. Quantum Chemistry, R.K. Prasad, New Age International, 2nd edition, (2000).
6. Quantum Chemistry through problems and solutions, R.K. Prasad, New Age International (1997).
7. Chemical Kinetics- K.J. Laidler, McGraw Hill. Inc. New York (1988).
8. Principles of Chemical Kinetics - House J.E. Wm C Brown Publisher, Boston, (1997).
9. Kinetics and Mechanism - A.A. Frost and R.G. Pearson, John-Wiley, New York, (1961).
10. Chemical Kinetic Methods - C. Kalidas, New Age International Publisher, New Delhi (1995)
11. S.H. Maran and C.F. Pruton, 4th Edn., Oxford, and IBH publishing Co. Pvt. Ltd. New Delhi (1965).
12. Principles of Physical Chemistry: Puri, Sharma and Pathania, Vishal Publishing House.
13. Essential of Physical Chemistry; Arun Bahl, B.S. Bahi and G.D. Tuli, S. Chand and Co.
14. Physical chemistry; R. L. Madan, G. D. Tuli, S. Chand and Co.
15. Elements of Physical Chemistry - Glasstone and Lewis - Macmillan.
16. Text book of Physical Chemistry - S. Glasstone- Macmillan (India) Ltd.
17. Numerical Problems on Physical Chemistry- Gashal, Books and Allied (P) Ltd.,
18. Physical Chemistry, P. C. Rakshit, V Edition (1988), Fourth Reprint (1997), Sarat Book House, Calcutta.
19. W. Kauzmann, Kinetic Theory of Gases (Thermal Properties of Matter, Vol I), Benjamin, Reading, MA, 1966.

Formative assessment for theory	Marks
Assessment type	
Internal Assessment Test- 1	15
Internal Assessment Test- 2	15
Assignment/ Small project	05
Assignment	05
Total	40 Marks
Formative Assessment as per guidelines	

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B.Sc. Semester-V

Discipline Specific Course (DSC)-15

Course Title: Physical Chemistry Practical:

Type of course	Theory/ Practical	Credits	Instructions Hour per week	Total No. of Lectures/hours semester	Duration of exam	Formative Assessment	Summative assessment	Total
DSC-15	**Practicals**	**02**	**04**	**60**	**02**	**25**	**25**	**50**

Course Outcomes:

At end of the course, students will be able to:

1. Understand to apply the knowledge of conductivity, emf and absorbance to performing the experiments
2. Acquire skills for handling analytical instruments like potentiometer, conductometer, pH meter and Colorimeter.

DSC-14: Physical Chemistry Practicals:

PART-A:

1. Conductometric titration of weak acid versus weak base.
2. Conductometric titration of solution of strong acid (HC1) and salt ($CuSO_4$) versus Strong Base.
3. Potentiometric titration of FAS versus $K_2Cr_20_7$.
4. Potentiometric titration of FAS versus $KMnO_4$.
5. Potentiometric method of determination of dissociation constant of H_3PO_4.
6. Potentiometric titration of weak acid against a strong base using quinhydrone electrode and calculation of pK_a and K_a of the weak acid.
7. Determination of the acidic and basic dissociation constant and isoelectric point of an amino acid by pH-metry.

PART-B:

1. Determination of rate constant of hydrolysis of ester in presence of two different concentrations of catalyst (HC1).
2. Determination of rate constant of hydrolysis of ester catalyzed by HC1 at different temperatures.
3. Determination of rate constant of decomposition of Hydrogen peroxide catalyzed by $FeCl_3$.
4. Determination of degree of hydrolysis of aniline hydrochloride at room temperature and calculation of dissociation constant of the base by/>H-metry.
5. Analysis of a binary mixture of two miscible liquids and to determine the composition of the given unknown mixture by Abbe's refractometry.
6. Determination of pH of acetic acid with sodium acetate buffer by/>H-metry method.
7. Colorimetric estimation of Fe^{2+} ions using 1,10-phenothralene.

Note: The list of experiments is suggestive. However, faculties / academic bodies may add more experiments / references or incorporate suitable revisions based on infrastructure facilities available at the Institution.

DSC-15 : SPECTROSCOPY : Theory - 60 hours

Unit-I: **15 hours**

Symmetry and Group Theory in Chemistry: (7 hours)

Definition of groups, sub-groups, cyclic groups, conjugate relationships, classes, simple theorems in group theory. Symmetry elements and symmetry operations, point groups, Schoenflies notations, representations of groups by matrices, reducible and irreducible representations, characters of representations, Great Orthogonality Theorem (without proof) and its applications, group multiplication tables for C_{2v} (Example : water) C_{3v} (Example : ammonia), character tables for C_n (consider C_2 and H_2O_2 as an example for C_2 point group), C_{nv} (consider C_{2v} and water as an example for C_{2v} point group), D_{nh} (consider D_{3h} and BF_3 as an example for D_{3h} point group) point groups to be worked out.

Molecular spectroscopy : (8 hours)

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies. Fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, PQR branches.

Raman spectroscopy: Theory, Qualitative treatment of Rotational Raman effect; Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion. Relation with IR spectroscopy, Instrumentation.

Unit-II: **15 hours**

Organic Spectroscopy:

General principles, Introduction to absorption and emission spectroscopy.

UV **Spectroscopy:** Types of electronic transitions,)i,$_{max}$,Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation *of*k_{max} for the following systems: a,(3 unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; Range, finger print region, and its significance; frequency and energy of IR radiations, interaction of IR radiation with organic molecules, molecular vibrations- stretching and bending vibrations, Hook's law, Stretching frequency of functional groups in benzaldehyde, acetophenone, ethyl acetate, aniline and methyl amine. Infrared spectra of simple molecules, C=C stretching and -C=H bending vibrations in vinyl ethers. Calculation of vibrational frequencies using Hooke's law derived for the motion of a spring. Sample handling in IR spectra of both gases and liquids.

Unit-Ill: **15 hours**

Nuclear Magnetic Resonance spectroscopy:

Nuclear magnetic resonance (NMR) spectroscopy: Absorption of electromagnetic radiation, proton NMR (H NMR) , Magnetic properties of nuclei, population of energy levels, the Larmor precession, relaxation processes, chemical shift, the relationship between number of signals and their ratio, shielding mechanism, spin-spin interactions, rules governing the interpretation of first order spectra, effect of chemical exchange on spectra. NMR spectra: Downfield and up field position of a signal and integral curve. 'HNMR spectrum of organic molecules like ethanol, p-xylene. Factors influencing chemical shift, anisotropic effect.

Mass Spectrometry: Basic principles- Theory of mass spectrometry, instrumentation, mass spectrum, the molecular ion peak, determination of molecular formula, Mc-Lafferty rearrangement. Metastable ion peaks and their importance. Nitrogen rule. General transformation modes. Homolytic cleavage heterolytic cleavage. Retro-Deil's Alder reactions. Important features of mass spectra of hydrocarbons - alkanes, alkenes and cycloalkenes, alcohols, phenols, aldehydes, ketones, carboxylic acids.

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Unit-IV: **15 hours**

Atomic spectroscopy: Atomic absorption, atomic emission and atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

Electron Paramagnetic Resonance (EPR) Spectroscopy: Basic principles, selection rules, intensity, width, position of spectral line, multiplet structure of EPR spectra, hyperfine interaction, spin-orbit coupling, zero field splitting and Kramer's degeneracy, rules for interpreting spectra, factors affecting the magnitude of values. Instrumentation, applications to the study of free radicals, coordination compounds, biological studies and rate of electron exchange reactions.

Nuclear Quadrupole Resonance (NQR) Spectroscopy: Quadrupole nuclei, quadrapole movement, electric field gradient, the NQR experiment, structural information from NQR spectra.

Formative assessment for theory	Marks
Assessment type	
Internal Assessment Test- 1	15
Internal Assessment Test- 2	15
Assignment/ Small project	05
Assignment	05
Total	40 Marks
Formative Assessment as per guidelines	

B.Sc. Semester-V

Discipline Specific Course (DSC)-16

Course Title: Analytical and Organic Chemistry Practical:

Type of course	Theory/ Practical	Credits	Instructions Hour per week	Total No. of Lectures/hours semester	Duration of exam	Formative Assessment	Summative assessment	Total
DSC-16	**Practicals**	**02**	**04**	**60**	**02**	**25**	**25**	**50**

Course Outcomes:

At end of the course, students will be able to:

1. Understand the types, theory, technique and application of separation techniques, like solvent extraction and chromatography, diyes and colours used in day-to-day life.
2. To understand to apply the knowledge of analytical technique for performing the experiments.

References:

1. Chemical Applications of Group Theory, F. A. CoZon, Wiley Eastern (1976).
2. Molecular Symmetry, D. S. Schonl and, Van Nostr and (1965).
3. Introduction to Molecular Spectroscopy, C. N. Banwell, TMH EdiBon (1994).
4. Introduction to Molecular Spectroscopy, G. M. Barrow, McGraw Hill (Int. Students Edition) (1988).
5. Molecular Spectroscopy, J. D. Graybeal, McGraw Hill (Int. Students EdiBon) (1990).
6. Spectroscopy, Vols. 1-3, B. P. Straughan and W. Walker, Chapman Hall (1976).
7. Physical Methods in Chemistry - R.S. Drago, Saundercollege.
8. Structural Methods in Inorganic Chemistry - E.A. Ebsworth, D. W.H. Ranbin and S.Cradock, ELBS.
9. Spectra of Inorganic and Coordination Compounds - K. Nakamoto.
10. Infrared Spectroscopy - C.N.R. Rao.
11. Introduction to Spectroscopy - D.L. Pavia, G.M. Lampman and G.S. Kriz, Thomson Learning, Singapore (2001).
12. Spectroscopic Identification of organic compounds - R.M. Silverstein and F.X. Webster, 6th Edition, John Wiley and Sons, India Ltd. (2006).
13. Interpretation of Mass Spectroscopy - Me Lafferty.
14. Organic Spectroscopy, William Kemp.

DSC-16 : Analytical and Industrial Chemistry Practicals:-

Part-A: Separation techniques and pharmaceutical analysis

1. Separation of amino acids by paper chromatography and measuring Rf values.
2. Separation of Co^{2+} and Ni^{2+} by paper chromatography and measuring Rf values.
3. Separation of Ni(II) and Fe(II) by complexation with DMG, extraction of Ni(II)-DMG complex in chloroform and determination of its concentration by colorimetry.
4. Separation of amino acids from organic acids by ion exchange chromatography.
5. Separation of Mg (II) and Fe (II) by ion exchange chromatogrphy.
6. Determination of aspirin present in tablets conductometrically / titrimetrically
7. Determination of amino acids colorimetrically using ninhydrin.
8. Determination of Glucose / Sucrose colorimetrically using Fehling's Solution.
9. Preparation of magnesium bisilicate (Antacid).

Part-B: Industrial Chemistry

1. Safety practices in the Chemistry laboratories.
2. Determination of calcium in fertilizer.
3. Determination of water of crystallization and Fe(II) in Mohr's salt by titrating with standard KMnO4
4. Preparation of phenol formaldehyde Resin.
5. Preparation of urea formaldehyde resin.
6. Nitration of salicylic acid by green method (Using calcium nitrate and acetic acid).
7. Preparation of aspirin from salicylic acid.
8. Analysis of Cement [Moisture, Silica and Calcium (II)].
9. Analysis of food adulterants in Tea Powder, Coffee Powder, turmeric powder, Chili Powder, oil/fat, milk, etc.
10. IR peak analysis for functional groups using recoded IR Spectra.
11. Preparation and characterization of biodiesel from vegetable oil/waste cooking oil.

Note: The list of experiments is suggestive. However, faculties / academic bodies may add more experiments / references or incorporate suitable revisions based on infrastructure facilities available at the Institution.

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DEPARTMENT OF CHEMISTRY

QUESTION PAPER PATTERN FOR FIFTH AND SIXTH SEMESTERS

Paper Title and Code:

[Time: 2 hrs] [Max. Marks: 60]

Instruction to candidates:

1) The question paper contains Three section A, B and C, Answer all Sections.
2) Write equations and neat diagrams wherever necessary.
3) Equal weightage shall be given to each unit.

SECTION–A

Answer any FIVE of the Following Questions. (5×2=10)

1. a)
   b)
   c)
   d)
   e)
   f)
   g)
   h)

SECTION–B

Answer any FOUR of the Following Questions. (4×5=20)

2. a)
   b)
3. a)
   b)
4. a) One question from each Unit
   b)
5. a)
   b)
6. a)
   b) Questions from Unit-I and II
7. a)
   b) Questions from Unit-III and IV (3+2 / 2+3)

1. 2. 3. 4. 5.
6. 7. 8. 9.

SECTION–C

Answer any THREE of the Following Questions. (3×10=30)

8. a)
   b)
9. a)
   b)
10. a) One full question from each Unit (5+5 / 6+4 / 4+6)
    b)
11. a)
    b)
12. a)
    i)
    ii) Questions from (Unit-I and II) (3+2 / 2+3)
    b)
    i)
    ii) Questions from (Unit-III and IV) (3+2 / 2+3)